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Education and Training

INFORMATION FOR DESIGNERS OF INSTRUCTIONAL SYSTEMS
ISD AUTOMATED TOOLS/WHAT WORKS

This volume provides information and guidance for applying current instructional technology and the Instructional System Development (ISD) process described in AFMAN 36-2234. This volume is not a directive, but may be useful to all Air Force personnel who plan, develop, approve, administer, or manage Air Force instructional programs. The use of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

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Chapter 1

GENERAL INFORMATION

Overview

Introduction

For many years, the military services have developed and applied instructional technology. In this evolutionary process, we need to continually learn better ways of instruction.

Mission Objective

One objective of the Air Force is training personnel to meet mission requirements. Therefore, to help fulfill that objective, we must:

- Apply the best methods in all phases of education and training.
- Continuously evaluate those methods to ensure quality is totally integrated.

Education and training efficiency and effectiveness result when quality is integrated.

Source

In 1988, the Department of the Navy, in an attempt to improve their Education and Background Training Program, ventured out to see what educational techniques and automated tools were being used in the civilian classroom.

The result of their effort was the publishing of "What Works - A Summary of Research Findings with Implications for Navy Instruction and Learning" (Montague, 1988). The Navy allowed us to borrow their publication findings in order for us to create our own volume.

Purpose

Many of you will find what is suggested in this volume to be common sense. However, common sense is not necessarily common practice. The information contained in this volume has four purposes:

- It serves as a reminder and guide to implement improvements within the constraints of current education and training situations.
- It provides information to assist with the long-term planning for education and training improvement.
- It provides the Education and Training Manager, Instructor and Specialist with a myriad of techniques proven effective to improve the quality of instructional programs.
- It provides several automated tools currently in the Air Force inventory that could enhance the classroom learning experience.

Limitations

We know these techniques and automated tools are not inclusive. You may not be able to apply some of these techniques and tools in all of the Air Force Education and Training centers of learning.

Goal

Our goal is to provide a forum to exchange classroom-proven practices which will increase knowledge and skills retention, yielding greater job proficiency as well as mission readiness.

Revisions

Please send us your proven techniques and tools so we may incorporate them in future revisions.

Format

The Navy examined the roles, responsibilities, and functions of the three different user groups (managers, instructors, and specialists) by constructing "A Plan for Achieving Excellence in Navy Training." We have borrowed the format in the matrix to look at the same areas within the Air Force.

Group Actions The plan consists of actions (shown in the left column) that each group should focus on to help optimize the quality of Air Force classroom education and training. The functions and roles of each group were examined to determine how classroom instruction could be improved.

Research Findings The research findings (shown in the right column) are paired with the actions and provide information that will assist users in carrying out these actions. We know some areas will overlap because each of the three categories examine the same areas of interest. However, what is discussed in each category is slanted toward the responsibilities of that particular category. It is a unique way at looking at responsibilities.

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A Plan for Achieving Excellence in Air Force Education and Training: Managers

Table 1.1

Managers Can:	**Findings:**
1. Become assertive instructional leaders by putting instructional excellence first.	**School Learning Environment**: Effective schools focus sharply on learners and learning.
2. Focus programs on instructional goals and protect them from irrelevant demands	
3. Demand high quality training from staff, instructors, and students.	**Managing Instructors:** Effective training management policies improve instructor training, student performance, and training time management.
4. Develop and monitor in-service staff training.	**Evaluating and Supervising Instructors:** Managers enhance instructor teaching skills by making frequent and systematic classroom observations and providing instructors with relevant and timely feedback that includes suggestions for correcting weaknesses.
5. Encourage consensus on values and goals.	**Managing Student Learning:** Performance-oriented leadership improves both formal (intentional) and informal (incidental) learning.
6. Establish a system for evaluation and monitor it systematically.	**Monitoring and Tailoring an Instructional System:** Instruction improves when managers monitor achievement indicators, detect when the value of any indicator moves into an unacceptable range, and then takes corrective action.
7. Bring instructional technology and good practices to bear on instruction.	**Course Evaluation and Revision:** Tryouts during instructional materials development help diagnose and repair inadequacies in the instruction. **Imitating the Working Environment for Learning:** Students learn and retain knowledge and skills best when the learning environment incorporates the critical, functional features of the regular working environment. **Maintaining Skills and Knowledge:** To maintain critical skills requires systematically planned and monitored on-the-job rehearsal and testing. **Student-Instructor Ratio Tradeoffs:** Enlarging class size in moderately large basic courses has little, if any, effect on student learning while freeing some instructors for laboratory training, tutoring, or counseling.
8. Promote a positive climate and atmosphere	**Managing Informal Learning:** A focus on managing learning can improve the incidence and quality of informal learning in Air Force environments.
9. Plan and coordinate long-range changes in training to increase effectiveness and efficiency.	**Planning Changes In Conducting Training:** Exploiting communications and computer technology can serve policy goals and meet training needs within resource constraints.
10. Analyse and plan for use of technology to increase productivity.	**Cost Effectiveness:** Consistent and credible evaluations of cost effectiveness must justify any plans to substitute alternative training programs for those now in use.
11. Consult with training specialists about training policy and practices	**Structured Instruction:** Students can learn as well from structured instructional material and self-study as from conventional classroom procedures. **Computer-based Instruction:** Students learn the same content as well or better from computer-based instruction as in a regular classroom situation, complete the lessons faster, and the course materials can be widely distributed and given at any time. **Video Technologies for Instruction:** Video technologies can portray world events, equipment, or tasks and can deliver interactive instruction to learners at formal schools and remote work sites. **Training Devices for Task Simulation and Practice:** Simulators enable learners to acquire the knowledge they need to operate and repair devices, to practice at speeds not constrained by real time, and at a fraction of training cost using actual equipment. **Distributed Instruction:** Students not at formal schools can interact with instructors through modem communications technology such as networked computers with or without television. **Adopting Training Innovations:** Managers and training developers can affect the rate at which the schools and instructors adopt and use newly developed training materials and programs.

A Plan for Achieving Excellence in Air Force Education and Training: Instructors

Table 1.2

Instructors Can:	**Findings:**
1. Bring good practices to bear on training and education	**Rating Instructors:** Feedback from student ratings enables instructors to improve their performance.
2. Focus classroom activities on learning	**Instructor Classroom Role:** Student activities during learning are more important in determining what is learned than the instructor's presentation. Instructors aid student achievement by getting students to engage in activities that are likely to result in learning. **Instructor Classroom Leadership:** Effective instructor classroom leadership promotes effective student learning.
3. Emphasize student learning and achievement	**Teaching Students How To Learn:** The way students study influences what and how much they learn. Students can learn effective study strategies.
4. Monitor student studying and adjust their activities to maximize their effort and progress. *5.Give corrective feedback regularly*	**Testing Student Learning:** Frequent, systematic testing and assessing student progress informs students about their learning. Instructors and managers learn about strengths and weaknesses in both the student and instruction. **Giving Feedback to Students:** Students who receive constructive feedback about the accuracy and adequacy of their performance become more interested in the class and learn more.
6. Promote effective use of instructional time in learning	**Managing Class Time:** Students who spend more time actively engaged in learning, learn more than students who do not.
7. Learn and use teaching techniques that enhance student learning.	**Cooperation in Learning:** Cooperating with other students in learning often improves learning. **Peer Teaching:** Peer "teachers" and their students receive higher grades on tests and develop more positive attitudes toward the courses with peer teaching.
8. Provide well-structured presentations and classroom activities.	**Instructor Presentation Stimulates Learning:** Students perform best when their instructors inspire them to take an active role in their learning.
9. Arrange many and varied learning opportunities.	**Practice:** Practicing lesson-related tasks promotes learning new skills.
10. Create a job-like instructional situation. *11. Emphasize hands-on, job-like performance tests.*	**Promote Development of Mental Models:** When students act in accordance with a prescribed "model" of performance, they develop conceptual understanding that guides competent performance more effectively.
12. Test and question students to evaluate their learning progress and maintain motivation to learn.	**Motivating Students:** Learning improves when students know how to set their own goals and how to achieve them.
13. Provide students with opportunities for individualized work.	**Student Control of Learning:** Students' perception of who controls the key events in learning significantly affects their learning achievement.
14. Design out-of-class assignments to increase student achievement.	**Out-of-class Assignments:** Student performance improves significantly when instructors regularly give out-of-class assignments, make sure they are completed, and give explicit feedback about the adequacy of the completed assignment.

A Plan for Achieving Excellence in Air Force Education and Training: Specialists

Table 1.3

Instructional Specialists Can:	Findings:
1. Become assertive instructional leaders by emphasizing factors that bring about excellence. *2. Learn and apply scientific bases for training excellence.*	**Systematic Approaches to Instructional Design:** Systematic training design models provide tools for planning, organizing, and managing instructional development and limit the content to that clearly needed. **Learning Objectives:** Learning objectives that reflect instructional requirements directly are easy to test. **Writing Text Materials:** Enhance books and manuals through orientation, summaries, examples, and diagrams. **Readability of Instructional Materials:** Readability scores indicate approximately how much difficulty students will have reading or listening to training materials. **Learning Built on Knowledge:** Students learn best when instruction is adapted to their existing knowledge and background. **Using Examples and Nonexamples:** Providing students with good examples and contrasting them with bad examples teaches them desired knowledge and skills. **Motivating Student Learning:** When instruction gets students' attention, is perceived as relevant and as having attainable goals, and provides frequent testing and explanatory feedback, students work hard, achieve well and enjoy learning. **Designing Effective Illustrations and Graphs:** Diagrams, graphs, photographs, and illustrations can improve learning. **See Findings under numbers 9,10,11 in Table 1.2**
3. Expect high quality and productivity from staff, instructors and students. *4. Implement and monitor in-service staff training.*	**See Findings under numbers 3.6 in Table 1.1.**
5. Monitor and evaluate instructors and instruction.	**Formative Evaluation of Instruction.** Tryouts of instruction determine where representative students have difficulty in understanding, testing, and instructional efficacy.
6. Promote interaction among instructors. *7. Protect instruction from irrelevant demands.* *8. Develop well-structured, work-like training emvironment to support student learning.*	**See Findings under numbers 3.6 in Table 1.1.** **Using Simulation for Training:** Effective simulation provides systematic practice, feedback about errors, and depicts how a device or system works, but may violate physical and temporal fidelity. **See Findings under numbers 10,11, in Table 1.2.**
10. Assist instructors in providing feedback to students.	**See Findings under numbers 3,4,5 in Table 1.2.**
11. Monitor development and empirical evaluation of training technologies	**Maintaining Consistency of Objectives, Testing, and Instruction:** Course effectiveness and efficiency depends on the consistency between training requirements, implied task requirements, objectives, task statements, and how instruction is presented. **See Findings under numbers 4,9,11 in Table 1.1, number 10-11 in Table 1.2.**
12. Analyze and propose improvements in training effectiveness and efficiency.	**Distributing Training Over Time:** Spacing learning or practice over several sessions separated by other activities makes training more effective than equal amounts of massed or concentrated practice. **Cooperation Among Students in Learning:** Students who help each other and work together learn more than those who learn alone. **Memorization Aids:** Mnemonic devices or coding systems help students recall important information when needed.
13. Provide input to higher management regarding training policy.	**See Findings under number 9-11 in Table 1.1.**

Chapter 2

EDUCATION and TRAINING TECHNIQUES

Overview

Introduction Education and Training involves a diversity of personnel working in various capacities, as the previous matrix points out. This section will look at the instructional techniques that relate to all education and training personnel; however, for ease in reference, three major categories are used: instructional managers, instructors, and specialists.

Where to Read About It This chapter contains three sections.

Section A

Techniques for Instructional Managers

Where To Read About It ..... The following topical index is provided as a quick reference to this section.

Effective Schools

Important Finding **Effective schools focus sharply on students and learning**

Effective Instruction Instructional managers and instructors can increase instructional quality by implementing policies that encourage effective instruction as:

- They emphasize frequent testing, testing of job-like performance, critical job skills, and safety practices.
- They encourage effective time management to reduce or eliminate time spent on activities irrelevant to training objectives.
- They maximize interaction between students and instructors, learning materials and learning tasks.

Students Students must be psychologically and physically comfortable. Long lectures requiring prolonged periods of sitting without opportunities for practice inhibit effective learning.

Managers Managers must work with instructors, students, and the operational community to develop and establish a positive learning environment that will become a lasting part of the school's tradition.

Instructors Instructors must collaborate in developing goals, sharing advice about teaching, and emphasizing student achievement, instruction as well as students' performance improves.

Managing Instructors

Important Finding **Effective instructional management policies improve instructors' training, student performance, and time management.**

Effective Managers With instructional improvement as a constant theme, effective managers should:

- Scrutinize existing practices to ensure instructor training contributes to the quality of instructional programs.
- Provide instructors with the opportunity to improve their instructional and classroom management techniques.
- Develop policies to support instructor requirements by encouraging new ideas.
- Ensure the availability of instructional materials and assistance instructors need.
- Work to raise instructor morale and create a climate of achievement.
- Allow instructors to participate in policy formation processes.

Evaluating and Supervising Instructors

Managers Managers enhance instructors' teaching skills by:

- Making frequent and systematic classroom observations.
- Providing relevant, timely feedback that includes suggestions for correcting weaknesses and praise strengths.
- Ensuring instructors know the subject matter and can teach it well.
- Providing new instructors opportunities to practice under supervised conditions.

Supervision Supervision that strengthens instruction has the following elements:

- The supervisor and instructor agree with specific skills and

practices that characterize effective teaching.

- The supervisor observes the instructor frequently to verify use of these skills and practices.
- The supervisor and instructor discuss supervisory observations.
- The supervisor and instructor agree on areas for improvement.
- The supervisor and instructor jointly develop specific improvement plans.

Student Ratings

Managers can use student ratings of instructors to improve the overall instructional processes as:

- Ratings may provide useful, constructive feedback.
- Ratings during a course, rather than only at the end, provide the opportunity to modify teaching with the same groups of students.
- Fellow instructors or education/training specialists can help individual instructors plan how to improve their teaching based on student feedback.

Managing Students

Important Finding

Performance-oriented leadership improves formal (intentional) and informal (incidental) learning.

Manage Learning

To manage learning effectively both inside and outside of the ...classroom, managers should:

- Ensure that formal learning is developed with systematic procedures.
- Stress the importance of each student's learning.
- Specify the roles of all personnel in managing learning.
- Personally evaluate the learning environment i.e., who is doing what, when, where, why, and how? How does the physical learning environment affect learning? What is happening in the school that should not be happening?

Outside Learning

Students learn a lot outside of formal education and training. For example, some students adopt behaviors from instructors during instruction; others acquire skills from peers.

Monitoring and Tailoring

Important Finding

Instruction improves when managers monitor achievement indicators, detect when the value of any indicator moves into an unacceptable range, and then take focused, corrective action (tailoring).

Controlling Instruction

Monitoring and tailoring instructional systems are similar to controlling physical systems such as heating or cooling systems. However, education and training system indicators are not as apparent as physical system indicators.

System Indicators

Education and training system indicators are determined by:

- Examining the goals and management practices of the school
- Obtaining objective information about students and instructors.

Monitoring

Monitoring focuses on improvement in instructional quality. Training managers can monitor direct and indirect student performances to establish priorities for improving the system:

.

- Monitoring requires access to effective record-keeping and considerable information processing.
- Monitoring with a computer-based information system, managers can identify student indicators with values that are in an unacceptable range.
- Monitoring will reveal whether the quality of instruction is being improved.

Monitoring Indicators

Training managers can monitor direct and indirect student performances to establish priorities for improving the system. The following indicators are helpful in the monitoring process:

- Direct indicators include student attrition, and comprehensive and performance test scores.

- Indirect indicators include student-instructor ratios and background variables.

Tailoring

Focused corrective action or tailoring requires a deployable resource to respond to the indicators. For example, an instructional supervisor or curriculum standards office representative might visit a classroom or school to confirm (or refute) that a problem exists, diagnose the situation, and propose corrective action.

Conclusion

The monitoring and tailoring approach assumes that fine tuning the instructional system can improve the system significantly. The system may require fundamental changes due to changes in technology, resources, or society.

Evaluation and Revision

Important Finding

Tryouts during instructional development help identify and correct inadequacies.

Student Tryouts

Evaluating and revising instruction are important processes. The developer accomplishes this by taking segments of material to a sample of students for tryout. This developer goes through the material with each student. During tryouts, students might be asked about:

- The quantity and quality of examples in the instruction.
- The adequacy of practice opportunities
- The suitability of media selected for a given education and training domain.
- The compatibility of the reading grade level of the materials and the student audience.
- The time required for the student to complete the instruction compared to allotted training time.

Revision

The developer then revises the materials to address problems uncovered in tryout and conducts another tryout with different students.

Summary

Instructional development rarely includes this evaluation-revision cycle. Tryout of materials in nearly final form are more common. At this late stage,

it is difficult to diagnose instructional problems unless gross failure make them apparent.

Conclusion The lack of evaluation during development makes revision of instruction a major undertaking. Looking at the ISD process as continuous evaluation will help resolve this dilemmna.

Lesson Learned The lesson learned is that managers who plan and allocate adequate resources for early evaluation make the revision process and instruction more effective.

Imitating the Job Environment

Important Finding **Students learn and retain knowledge and skills best when the learning environment incorporates the critical, functional features of the working environment.**

Job Transfer For maximum transfer from the education and training emvironment to a work environment:

- The learning environment should include the context, tasks, procedures, and materials of the job.
- Education and training should relate to the specific job environment, as well as the knowledge the student already has.
- Training should involve the same operations, tools, and machines (or their functional equivalents) as the actual job.

New Built on Old New knowledge is built on the foundation of old knowledge. Facilitating learning requires that training relate to students' existing knowledge. Students can use existing knowledge to facilitate learning and correct any misunderstandings of how and why things work the way they do. This will help bridge the gap on what new knowledge needs to be taught.

Job Performance

Another important aspect of imitating the job environment is training students to the level of the job performance requirements. If the job requires much supervision, then students should not be trained to a high level--one that does not require supervision. Effective education and training managers should solicit graduate feedback to detect inconsistencies between training levels and job performance requirements.

Tailor to Assignment

Minimal on-the-job supervision requires higher levels of training. If training and working environments differ in their skill expectations and closeness of supervision, instruction should be tailored for the expected assignment.

Solicit Feedback

Effective education and training managers should solicit feedback about graduates to detect problems in mismatches between levels of training and expectancies.

Maintaining Skills and Knowledge

Important Finding

Maintaining critical skills requires planned and monitored on-the-job training and testing.

Skill Loss

- Performance of some procedural skills declines rapidly without systematic refresher training.
- The rate of skill loss differs for different tasks. The decline suggests the need for systematic practice to maintain skills.

Example of Skill Loss

Figure 1, taken from Hagman and Rose (1983), shows the decline in the number of soldiers able to perform basic soldiering tasks after training. Rate of skill loss differs for different tasks. The decline suggests the need for systematic practice to maintain skills.

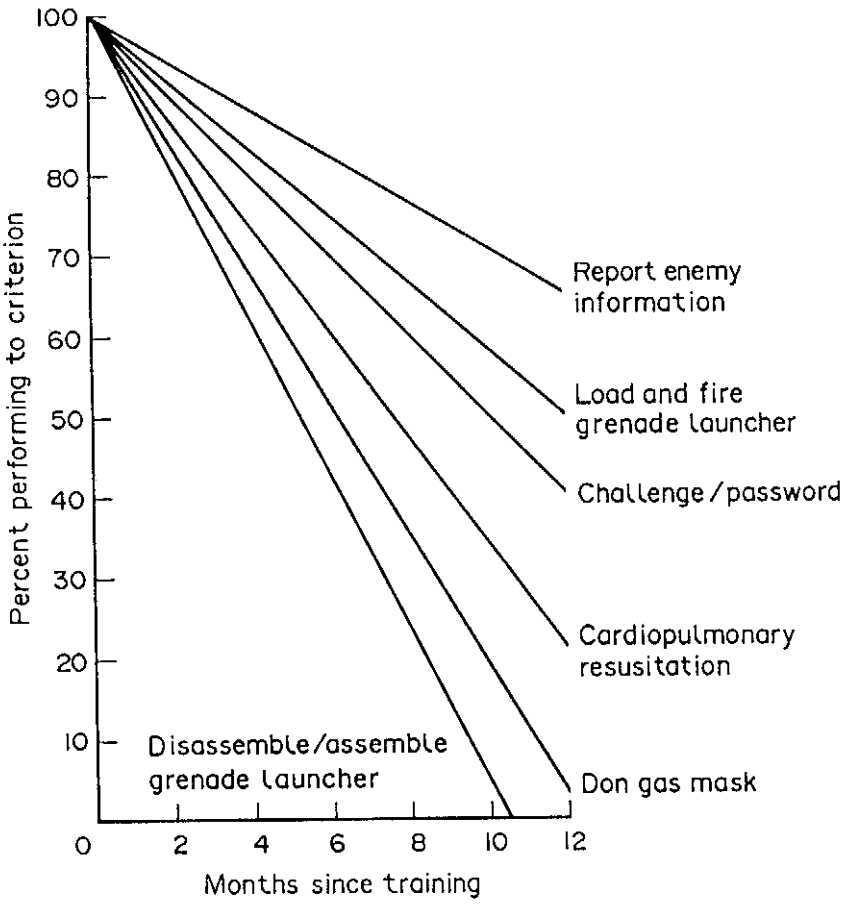


Figure 1. Rate of Skill Loss

Preventing Skill Loss

Normally, schools provide sufficient training for initial job competency. Proficiency is normally developed on-the-job. The following applies to maintaining proficiency:

- On-the-job practice of rarely used skills is often lacking.
- Long lapses in training promote losses not

improvement of skills and knowledge.

- Initial training must include the maximum amount of practice possible.
- Retraining must be provided at intervals.

Estimating Skill Loss

There is no way to make accurate, quantitative predictions about the rate of skill loss, how fast relearning occurs, or how often retraining should occur.

Refresher Training

The bottom line is that planning and scheduling refresher training are essential.

- Base the spacing of refresher practice sessions for novices on how often trainees perform the skill or task.
- More than minimal learning should be provided during the original course when refresher training is difficult or too costly to arrange.

Student and Instructor Ratios

Important Finding

Enlarging class size in most large basic courses has little effect on student learning. It frees instructors for lab training, tutoring, or counseling.

Class Size

Class size has the following relationships to learning:

- Small student-instructor ratios tend to promote frequent interactions between students, instructors, and materials.
- Students in small classes achieve more; they also have more interest in learning.
- When class size exceeds 12 students, fewer opportunities for class participation exist.
- In lecture presentations, class size does not make any difference because interactions are minimal, even in the informal lecture arena.
- Class size in basic courses, unless its below 10 students, does not affect student learning. If the class gets so large the student can neither see nor hear the instruction, this will become detrimental to learning.

Ratio Management

Managers should occasionally change instructor and student ratios to maximize instructors and improve student learning.

Merging classes to relieve some instructors can provide additional time for them to perform other instructional functions.

Managing Informal Learning

Important Finding

Aggressive management of learning can improve the incidence and quality of informal learning.

Informal Learning

Students obtain much of their knowledge and skills outside of formal training:

- Managers can positively influence informal learning by placing

instructional information in areas where students frequent (dormitories, cafeterias, etc.).

- Instructional information should be designed not only to foster learning, but also to create awareness and motivation.
- Instructional requirements can be promoted by placing instructional materials at job sites, requiring reading of job, and education and training materials during slack time.
- Students should be encouraged to set aside "read and think" time during duty hours. This will help them to think about what they do, and how to do it better.

Planning for Change

Important Finding

Exploiting communications and computer technologies can serve policy goals and meet education and training needs within resource constraints.

Capturing Technology

Many revolutionary changes in communications and computer technologies can be used for instructional purposes.

Effective Utilization

Various technologies can deliver instruction that can be as effective or more than current methods. To capture technological benefits, you must:

- Accomplish good analysis and planning.
- Compare cost effectiveness benefits with needs and the current costs of training.
- Identify funding for evaluation of new systems designed to make instruction more effective.

Cost Versus Impact

The rapid development of new technologies seems to point to the inevitability of significant changes in the way education and training is accomplished.

- Potential costs of these changes requires caution and a practical outlook.
- Claims of large benefits in effectiveness must be substantiated by concrete, conclusive empirical evidence.
- Decades of research reveal that improvements in instructional achievement are usually not due to the communications and computer technology but to redesign of the content.
- Permitting each student to learn at his own pace, with or

without technology, is an important source of the gain.

New Technology

New technology may make the delivery of novel and conventional forms of instruction in ways never thought possible.

Caution on Big Applications

Large scale implementation of education and training technologies that substantially change the organization and presentation of instruction should be undertaken only after formal study of its cost effectiveness.

Other References

The following paragraphs will present some of the technologies the training manager can use. Section C will review some of the latest tools, such as the Training Cost Estimator System (TRACES).

Cost Effectiveness

Important Finding

Consistent and credible evaluations of cost-effectiveness must justify any plans to substitute alternative education and training programs for those now in use.

Low Cost

Declining costs of computer-based and communications technologies makes their use in the delivery of instruction a smart move.

Must Make A Difference

Introducing new technology must make a difference and not add to increases in the already high cost of education and training.

Must Show Benefits

To offset or justify the cost of technology, these benefits should be demonstrable:

- Instructor productivity or the number of students graduated in a time period should increase.
- Student performance should improve substantially.
- Administrative burdens over the life of the system should be reduced.

Good Planning Changes require good management planning as well as changes in the instructional program.

Cost of Alternatives The decision to implement a particular instructional program, course or device, or to change to an existing one, rests upon identifying all the costs of all the alternatives, such as:

- The cost of research and development.
- All personnel costs in development.
- Development and delivery costs of all versions of equipment.
- The cost of running the implementation for the life of the system including operation and maintenance.

Summary When the conventional instructional system and a technology enhanced system demonstrate the same effectiveness, the one that costs the less might be preferred.

Conclusion Substantial demonstrated differences in instructional effectiveness must be considered before applying alternative programs, courses, or devices.

Structuring and Sequencing Instruction

Important Finding **Students learn as well from structured materials and self-study as from conventional classroom procedures. It works as well as conventional methods for teaching knowledge.**

How to Structure Structuring materials require you to do as follows:

- Divide instructional materials into learnable segments.
- Determine their presentation order.
- Require students to pass tests to demonstrate comprehension before allowing them to progress to new instruction.

Structuring Advantages

Structured instructional materials provide:

- Students an opportunity for self-paced study.
- Considerable saving of training time.
- Distribution to remote locations as alternatives to lectures.

Sequencing

Instructional sequencing is designed to require an active response from students before new information is presented.

Sequencing Advantages

Some of the advantages of sequencing to consider:

- Students get immediate feedback.
- Students may omit material they already know.
- Students may identify segments where errors require further study.
- Students may receive instruction on various media such as computers, workbooks, or lectures.

Structuring Examples

Many computer-aided instruction (CAI) programs are examples of structuring instruction; others use simulation or gaming techniques.

Self Paced Instruction

Important Finding

Students who progress through the materials at their own rate complete the materials in about one-third less time than do students who attend conventional courses.

Student Attitudes

Student preferences and attitudes in comparing self-paced with conventional instruction:

- Students prefer having an instructor present the instruction.
- Students prefer sitting in a classroom with a human being who can listen and respond rather than sitting in a media carrel.
- Students have similar attitudes toward the content in group or

self-paced.

Interactive Courseware

Important Finding

Students learn the same content as well or better from interactive courseware (ICW) as in the regular classroom.

ICW Advantages

Advantages of computer-based instruction are:

- Students complete lessons faster.
- Course materials can be widely distributed and given at any time.

Research on ICW Effectiveness

Figure 2, taken from Orlansky and String (1979), provides a graphic summary of a review of 40 research studies comparing the effectiveness of interactive courseware and standard training in the Air Force, Army, and Navy.

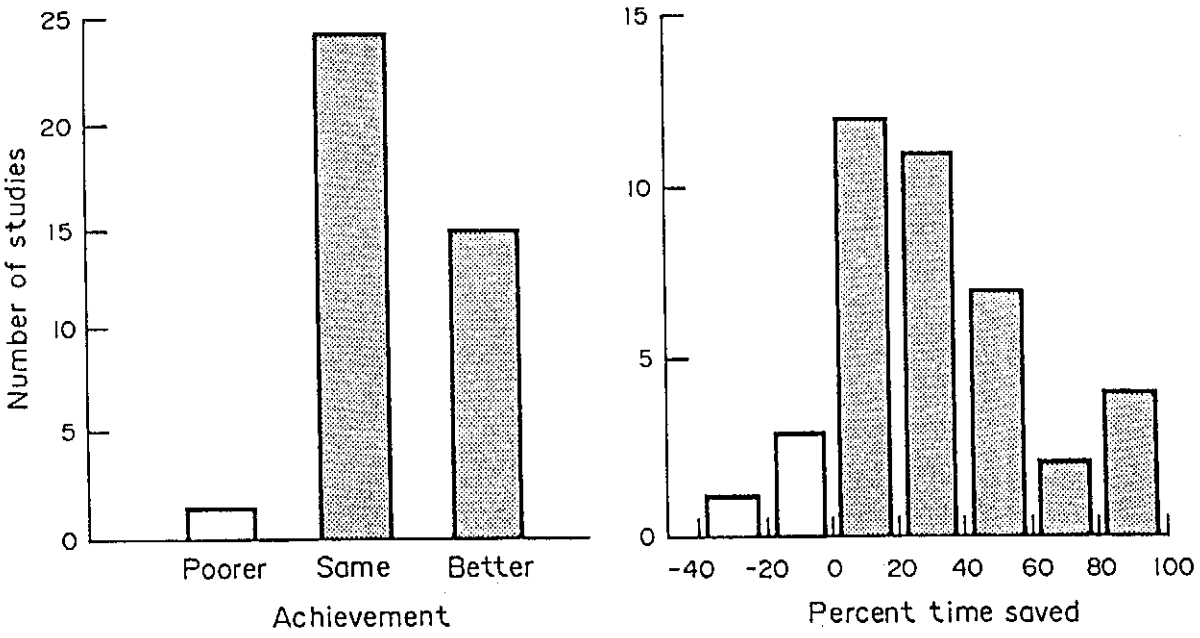


Figure 2. Effectiveness of Interactive Courseware

ICW Research Summary

The summarized results are as follows:

- Fifteen studies reported higher achievement for ICW students.
- Twenty-four studies reported no difference between student achievement in either form of instruction.
- One study reported lower achievement for ICW students.
- These studies indicate that students complete their lessons

in 30 percent less time with ICW.

Verified Suitability

These findings are important where students are paid and training time needs to be as brief as possible.

The evidence from the 40 research studies verify the suitability of interactive courseware in the military.

ICW Compared

A review of nearly 200 studies comparing ICW with conventional elementary, secondary, and college instruction found:

- ICW raised student achievement significantly.
- ICW students gained a better appreciation of technology.
- ICW led to improvement in student attitudes toward schools and teaching.
- ICW helped teachers manage instructional time.

Reasons for ICW Effectiveness

Effectiveness and efficiency gains do not result simply from using interactive courseware in the instruction. They result too from applying a **systems approach** to the course design and allowing students to progress at their own learning rates. Military courses normally require instructional ... systems development for all courses and so the **gains from ICW** would be ..... primarily **from time savings and not improved student performance.**

Careful Planning Required

Careful planning is necessary before deciding to use ICW In each situation, cost-effectiveness is a critical issue. True ICW is an excellent method of instruction but in some cases time and resources are not available to develop a course using these media.

Video Technologies

Important Finding

Video technologies can simulate world events, equipment, or tasks and deliver interactive instruction in formal schools and remote worksites, referred to as Interactive Video Disk Instruction (IVD).

Telecommunications Advantages

Telecommunications technologies have potential for delivering instruction to learners at formal schools and remote sites. Advantages are:

- Blends of technologies can provide learning experiences which emphasize interaction and individualized learning.
- Linked video and computer technologies can provide interactive training incorporating such important variables as immediate feedback, individualized pacing, and almost unlimited combinations of text, audio, graphics, and full-motion video.
- Multiple branching, immediate feedback, and individualized interaction are other inherent features.

IVD Advantages

IVD can enhance the effectiveness of computer-based instruction: IVD advantages are:

- Full motion video better supports learning objectives requiring observaton of people or machines in motion.
- Students completing IVD score considerably higher than students in traditional courses.
- Students in self-paced IVD learn the same or more in less time than in lecture-based presentations.

Needs Assessment

IVD requires needs assessment and cost-effectiveness analyses be performed before implementation.

Simulators

Important Finding

Simulators enable learners to acquire the knowledge they need to operate and repair devices. Learners can practice at speeds not constrained by real time at a fraction of training cost over using actual equipment. Simulators also decrease the risk of personal harm or damage to actual equipment.

Simulator Definition

Simulators may be devices that physically resemble actual equipment (a mock-up or part-task trainer) or a type of computer-based training (CBT) in which computer images or video are used to represent the equipment.

Simulator Advantages

Simulators offer many training advantages:

- They are cheaper to practice on than actual equipment.
- They are often easier to understand than the actual equipment because they can depict normally invisible functions and events such as electron flows.
- They can determine how much practice the student needs and can isolate and repeat the difficult segments of a task.
- They can present events at speeds that are much faster than real time.
- They present the effect of manipulations so they can be seen quickly.
- They provide the opportunity to accomplish additional practice quickly.
- They can incorporate important training variables such as detailed performance evaluation and feedback.

Development and Use of Simulators

Important Finding

Design, development, and use of simulators require careful planning and special skills.

Design Development Factors

The following factors are important to design and development of simulation devices:

- Design decisions must be related to the cognitive

processes required to learn the task rather than focusing on particular hardware or the medium.
- An effective simulator should isolate relevant cues while students learn to ignore irrelevant information.
- A simulator's effectiveness is more a function of the instructional methods used to support learning.
- A simulator's physical similarity to the device it represents does not determine its effectiveness.
- Tryouts with typical students are important to validate the design.

Analysis Required

Remember that needs assessment and cost-effectiveness analyses must be accomplished before acquiring this medium!

Distributed Learning and Tele-training

Important Finding

Students away from formal schools can interact with instructors through modern communications technology such as networked computers with or without television.

Electronic Network Advantages

Through instructional electronics networks, students alone or in small groups, can learn skills and knowledge where they will use them:

- Telephone computer networks control audio or electronic exchanges between students and instructors. Satellite links, cable television, or cassettes deliver video if needed.
- Participants work on problems peculiar to their own situation when their work schedule allows.
- Variations are possible. Participants can delay the interactions by saving questions, answers and comments until time is available to address them.

Tele-Training Advantages

Tele-training involving one-way video with two-way audio links is perhaps the best compromise between cost and information quality. The advantages are:

- This provides full presentation of visual information and allows students to ask questions or make comments at any time.
- Compressed two-way video is also becoming more economically feasible.
- Advent of large-scale digital networks and satellite links has made video teleleconferencing more commonplace.

Tele-Training Deterrents

- Deterrents to the use of tele-training are the significant preparation time, equipment costs, and relatively complex logistics required.

Benefits of Tele-Training

The following are benefits of tele-training:

- Enables new students to observe experienced specialists.
- Reaches learners where and when the training is needed.
- Shifts more responsibility for acquiring the skill from the trainer to the student.
- Saves travel cost by not requiring time away from job.

Micro-Computer Advantage

Microcomputers can also serve as terminals to remote data banks and network members. Through telephone connections and a centralized message workspace, learners can ask questions or propose solutions to other members sharing the network. This provides an inexpensive source for high quality ICW lessons, desktop simulators or simulations.

Adopting Change

Important Finding

Education and training managers and developers can affect the rate at which the schools and instructors adopt newly developed instructional materials and programs.

Adopting Strategies

- Training commands and schools should consider the strategies to use to encourage the potential users to adopt the new materials.
- One way of overcoming the "not invented here" attitude is to involve all potential users in the analysis and design phases of innovative courses.

Managing Change

Important Finding

Using an effective person as an agent to manage change is a critical factor in its spread.

Role of Change Agent

The agent studies the potential adopting organization and systematically shows that the innovation:

- Has obvious advantages over the existing process, materials, or equipment.
- Is compatible with the existing system.
- Is supported by significant research and/or evaluations
- Is a rational sequence for its adoption and application.
- Addresses an identified need of the potential user.
- Will be used for a long time.
- Can be adopted by the staff with minimum training.

Managing Change

To properly manage change, the manager must concentrate on the following related to:

- The potential users and their needs rather than the material or the innovation.
- The situation as well as the potential user.
- The need to tailor the innovation to the user's needs.
- The need to explain the innovation to the potential users.

Conclusion to Techniques for Instructional Managers

Manager Should Accomplish

After reviewing this Section, regarding important techniques for the instructional manager, you should now be able to accomplish the following:

- Become an assertive instructional leader by putting instructional excellence first.
- Focus programs on instructional goals and protect them from irrelevant demands.
- Demand high quality training from staff, instructors, and students.

- Develop and monitor in-service staff training.
- Encourage consensus on values and goals.
- Establish a system for evaluation and monitor it systematically.
- Bring instructional technology and good practices to bear on instruction.
- Promote a positive climate and overall atmosphere.
- Plan and coordinate long-range changes in education/training to increase effectiveness and efficiency.
- Analyze and plan for use of technology to increase productivity.
- Consult with education and training specialists about respective policy and practices.

Instructor Role

In the next section we will turn our attention to the most influential person in the eyes of the student, **the instructor.**

Section B

Techniques for Instructors

Where To Read About It

The following topical index is provided as a quick reference to this section.

Student Feedback

Important Finding

Instructors can improve their performance through careful analysis of student feedback.

Benefits of Student Ratings

When schools require students to rate instructors, they expect instructors to use the ratings for improving instructional techniques. Evaluation studies show that feedback from student ratings improves instructor performance:

- Research on college teaching revealed that instructors who received feedback from mid-semester ratings received substantially higher end-of-course ratings than instructors who were rated at the end of the semester.

- Ratings improve more when instructors discuss the mid-semester with consultants or received help in reacting to them.
- Instructors and managers can use ratings during a course to modify and improve teaching with the same groups.

Feedback Timing

As with all feedback, it is timing and content which influence its effectiveness. Other instructors or education and training specialists can help individual instructors improve their teaching through student feedback.

Student Activities

Important Finding

Student activities during learning are more important in determining what is learned than the instructor's presentation.

Planning Active Learning

Instructors aid student achievement by getting students to engage in activities that are likely to result in learning:

- Effective instructors not only present facts, ideas, or information but get students actively involved in appropriate learning activities to attain desired outcomes.
- Learning is an active process, and instructors should develop as many learning strategies as possible to help students achieve the objectives.

Prior Knowledge

During the learning processes, instructors should consider students' prior knowledge. Students' understanding of new information depends on how well they relate it to their prior knowledge:

- Students often begin learning with substantial misconceptions about the material they are studying and its intended use.
- Even students who get high grades have these misconceptions.
- Students make systematic errors based on misconceptions and erroneous procedures from prior knowledge.

Instructional Intent

Students should never begin instruction without understanding its intent:

- Instructors need to fully explain the instructional intent

(course objectives) and its relationship to the knowledge, skills, and attitudes the students already possess.
- Instructor must understand how current and prior knowledge determines what the students will learn from new material that conflicts with their existing beliefs.
- Students should be asked to reveal their misconceptions so that the instructor can address them.

Classroom Leadership

Important Finding

Effective instructor classroom leadership promotes effective student learning.

Instructor Leadership

Instructors lead students to learn by focusing on the following:

- Presenting well-conceived learning objectives.
- Conducting regular and comprehensive evaluations of student learning.
- Having high expectations of all students.
- Providing a purposeful learning environment.
- Concerning themselves with student performance.

Diversity of Opinion

Instructors should encourage diversity of opinion by:

- Pointing out relationships between various opinions and ideas.
- Stressing the variety of potential solutions to a problem.
- Protecting minority opinions.
- Keeping disagreement under control.

Peer Feedback

Peer-feedback improves instructional effectiveness. Instructors can observe each others' classroom procedures and provide constructive feedback.

Objective Grades

Students' grades should be based on objective attainment. Grades should not be used to correct disciplinary problems. Disciplinary

problems are reduced when students actively participate in learning.

Instuctor's Role

Instructors must accomplish the following:

- Help students perceive education and training as relevant and interesting.
- Use techniques to reinforce good behavior.
- Seek friendly relationships.
- Encourage students to cooperate with other students and staff.

Learning Strategies.

Important Finding

Study skills and strategies can influence what and how students ... learn. Students can learn effective study strategies.

Learning Strategies

Study or learning strategies may affect learner motivation or the way they select, acquire, organize, or integrate new knowledge. An example of these strategies would be:

- Learners my coach themselves to reduce anxiety.
- Learners may use imaging to relate vocabulary words and meanings.
- Learners may summarize and take notes to memorize written material.

Better Students Use Learning Strategies

Above average students use learning strategies to acquire, organize, or integrate new knowledge.

Students may use imaging to relate vocabulary words and meanings, or summarize and take notes to memorize written material.

Average Students Infrequently Use

Average and below average students use effective study strategies infrequently. They need to be taught how to use these strategies.

Once they have learned the strategies, all students can study and learn more efficiently. They must be encouraged to do so.

Factors in Student Study

Students can monitor and adjust the way they study based on:

- Whether they understand difficult material.
- How much time they have for studying.
- How much they know about the material.
- The standards they must meet.

Instructor Role for Improving Study Skills

Instructors' can help improve study skills by:

- Adjusting students' study methods according to content difficulty, time allowed for studying, familiarity with content, and standards required.
- Spreading study sessions on a topic over available time so students do not work continuously on a single topic.
- Using study strategies appropriate for learning a task. Use rehearsal and self-testing to memorize ordered lists, take notes that paraphrase a lecture, organize information in text by identifying main ideas and relating to current knowledge.
- Allowing students to assess their progress and modify the strategies as needed.

Effect of Training

Training in techniques for learning from text materials has a substantial effect on performance on tests covering the content studied.

An Example of Training Students to Learn Text

In the following example, students were taught:

- How to make a network map of the information in a text,
- How to make a spatial representation of the information.
- How to paraphrase.
- How to draw pictorial representations of ideas and concepts.

Four different measures were used to examine the effect of the training.

Figure 3, taken from Montague and Knirk, shows that trained students substantially outperformed untrained ones on essay and short-answer tests. The histogram bars show how much the scores of the trained students exceeded those of untrained students.

On a “cloze” test every nth word in the material is deleted, and the student tries to fill in the correct word from memory. Trained students showed superior performance on that type of test also. On a multiple-choice test trained students’ superiority was slight. This type of test is not as useful

a test for examining student learning and understanding.

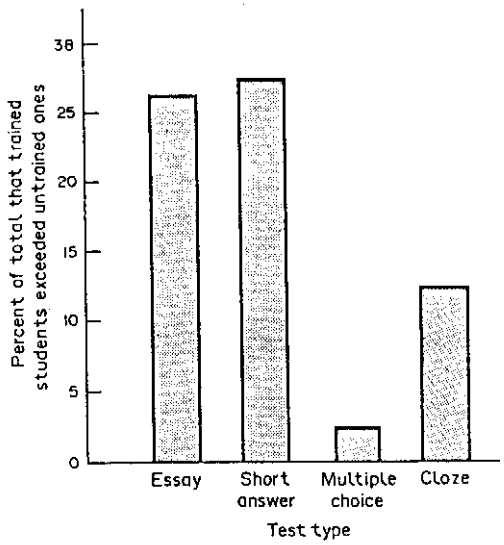


Figure 3. Effectiveness of Training Students to Learn from Text

Conclusion to Figure 3

Students given training in how to study text material outperform students not given training.

Testing Student Progress

Important Finding

Frequent, systematic testing and assessing of student progress informs students about their learning. Instructors and managers learn about strengths and weaknesses in student learning and the instruction.

Types of Tests

Students are tested to determine what they know and what they need to learn. Various types of tests can be used including observing laboratory exercise performance, giving oral quizzes and test, assigning homework, asking questions in the classroom, and giving comprehensive performance tests.

Advantages of Student Assessment

The following are advantages of student assessment:

- Student errors on tests and in class alert instructors to learning

problems that need to be corrected.

- Student motivation and achievement improve when instructors provide prompt feedback on their performance and assignments.
- Frequently tested students outperform less tested ones in the classroom.

Knowledge Tests

Students generally take either knowledge or performance tests. Knowledge tests help instructors find out if the students have learned information important for safety and knowledge important for performance.

Performance Tests

Performance tests enable instructors to determine student competence and identify student and instructor problems. The instructors' biggest concern with testing is to identify what the students do not know.

Job-like Tests

In technical training, assessment should be as job-like as possible. The following should be applied:

- Emphasizing hands on performance tests
- Limiting pencil and paper tests to safety and knowledge critical for job performance
- Testing with open-book where students use manuals and other references normally available on the job.

Performance Difficulties

Performance difficulties often indicate gaps in student knowledge. Student explanations of their actions or answers to questions can help instructors identify knowledge gaps.

Providing Students Feedback

Important Finding	**Students who receive constructive feedback about the accuracy and adequacy of their performance become more interested in the class and learn more.**
Immediate Feedback	Giving immediate, constructive student feedback is an effective way for instructors to aid student learning.
Student Feedback Characteristics	No one method is best for providing student feedback. Feedback should have the following characteristics: • The feedback should be prompt and provide useful information. • Feedback emphasizing the method used to get the correct answer reinforces the solution.
Features of Instructor Feedback	Instructor feedback should have the following features: • Instructors should give nonspecific praise and criticism infrequently. It should be based on the quality of student performance. • Instructors should explain correct or incorrect performance. This is better than to give only the correct answer or to judge the student performance. • Instructors' feedback should routinely tell students when they are incorrect. They should focus on the content and explain how to reach the correct answer. • Instructors' critical feedback, written or spoken, should be given in private and not in front of the class.
Benefits of Timely Feedback	Constructive, timely feedback, helps students develop self-esteem as well as improve performance: • Students who believe they can succeed are usually more successful than those who are less sure of their ability. • Students who believe they can succeed are more active learners, work independently, cooperate with other students, and achieve more.

Managing Active Learning Time

Important Finding

Students who are actively engaged in learning learn more than those passively involved.

Active Involvement

The time allocated for learning differs from the time students are "actually engaged" in learning. This difference becomes important in hands-on training, whereby the lack of available equipment sometimes causes students to spend time observing others.

Passive Exposure

Passive exposure to laboratory does not mean students are actively engaged in learning. Instructors should use techniques to engage all students in learning.

Effective Instructors

Effective instructors determine learning time accurately and use techniques that increase the time students spend on learning activities. The following techniques are helpful:

- Instructors minimize time for breaks and interruption of individual students. Students can help instructors analyze their classroom by identifying distracting events and procedures that could be changed.
- Instructors can increase students' attention to learning and increase learning time and achievement. Questions can focus on material or problems in texts or manuals.
- Instructors who summarize important information prepare students for studying.
- Students who are easily distracted may profit from out-of-class assignments that focus on overcoming the distractions and processing relevant content.
- Students who receive explicit feedback about their performance learn what is required of them and how to correct their actions.

Conclusion

Instructors who supplement a well-planned training program with these learning activities can achieve three major goals:

- They can capture the students' attention.
- They can make the best use of available learning time.
- They can encourage academic achievement.

Cooperative Learning

Important Finding

Cooperating with other students during learning often improves learning.

Cooperative Learning Advantages

Some advantages of cooperative learning are:

- Organizing students into small study groups improves performance on achievement tests.
- Arranging students into small groups promotes positive attitudes toward each other and learning.
- Organizing students into groups of two or three assists "team" activity and crew training for the Air Force.

Single Student Domination Eliminated

It is important that one student does not limit opportunities for learning by dominating others. This can be achieved by testing them separately or by instituting other procedures that ensure that each student spends an appropriate amount of time actively learning.

Cooperation Versus Competition

Students tend to avoid activities that they believe will result in failure. A competitive situation arouses the need to either achieve success or avoid failure.

Encouraging cooperation, rather than competition, among students promotes effective achievement and productivity.

Identifying Poor Performance

Instructors should demonstrate a cooperative spirit by not singling out poor performers. Self-esteem and ego are "on the line" when students are asked to perform in front of classmates.

Bad experiences in traditional education, feelings about authority, and the preoccupation with events outside the classroom all affect experiences in class. Singling out poor performers leads to negative attitudes toward the instructor and the students.

Conclusion

Instructors can increase student learning by promoting cooperative rather than competition among the students.

Students competing for grades or other extrinsic goals focus on beating other students rather than on understanding the course material and learning how to work as a team member.

Peer Teaching

Important Finding

Students who receive instruction from peer teachers receive higher grades and develop positive attitudes toward training.

Advantages of Peer Instruction

Peer instruction provides the following advantages:

- Peer interaction improves students' academic performances. and attitudes.
- Instructors can supplement regular classroom teaching with peer teaching.
- Peer instruction helps slower students succeed.
- Peer teachers benefit from preparing and giving lessons they prepare and present.

Peer Teaching

Peer teaching can take a variety of forms as:

- Instructor assistants leading discussion groups, seminars, or tutorial groups.
- Senior students assisting new students (see the proctor model at Figure 4).

- Student-led learning groups which have no instructors.

Raises Test Scores

Student coaching usually raises test scores (see Figure 4). The effects are greatest in long, cognitive and extensive drill-and-practice courses.

Short test-taking oriented courses show the least improvement as a result of coaching methods.

Effectiveness of Peer Instruction

The graph at Figure 4, taken from Montague and Knirk (1993), is based on actual student performance. It demonstrates the relationship between peer teaching (student coaching) and reduction in student attrition.

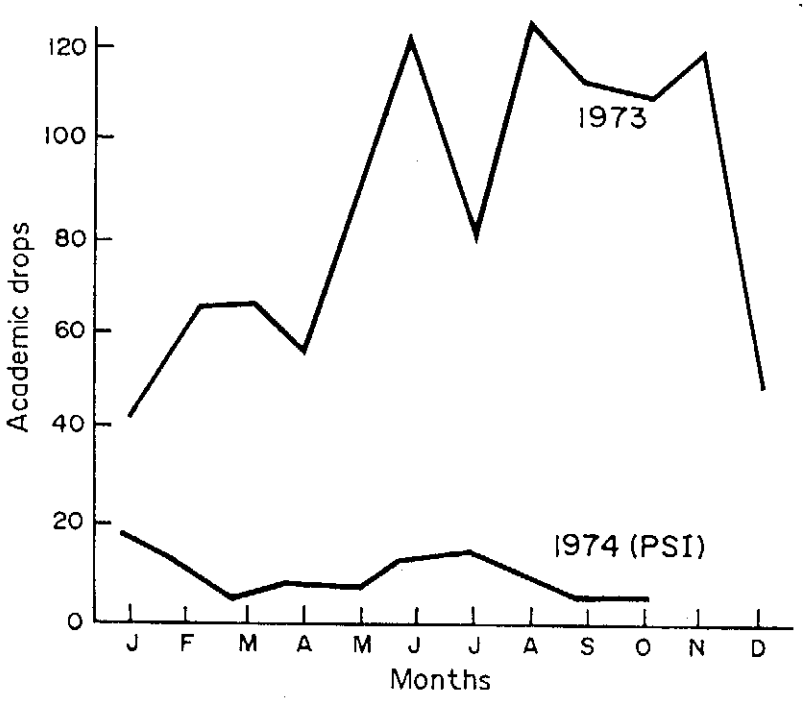


Figure 4. Effectiveness of Peer Teaching

Conclusion

Students bring a lot of invaluable life experiences into the classroom which should be acknowledged and used. Students can learn much through interacting with respected peers.

Effective Instructor Presentations

Important Finding

Students learn best when their instructors inspire them to take an active role in their learning.

Good

Good instructors are not only subject matter experts in what they

Instructors teach, but know how to teach. They are prepared to answer student questions and stimulate student interaction.

Factors for Effective Presentations

For effective presentations, instructors should keep the following concepts in mind:

- Present the material in a logical structure which can help students learn and remember. Students can remember only a small amount of material presented orally or visually.
- Present no more than two or three main ideas in a 15-minute segment.
- Use techniques to stimulate students to assume an active role in understanding what is taught.
- Present summaries to reemphasize main ideas, illustrations, tables, and charts.
- Use lesson enhancements which foster retention. Students are likely to remember the illustration used to teach a concept or practice.

Questioning Atmosphere

Instructors who maintain a questioning atmosphere force students to think and solve problems.

Ways To Stimulate Learning

Instructors can use the following techniques to stimulate learning:

- Ask students to summarize lessons.
- Challenge students by providing incorrect information to determine if they can provide the correct information.
- Divide students into small groups for discussions.
- Ask questions randomly during lectures.
- Relate directly to relevant "war stories" or anecdotes and explain their relevance clearly.

Demonstrate Task Steps

Students learn best when instructors demonstrate steps to accomplish a task.

Instructors should systematically demonstrate tasks, explaining the purpose and result of each activity. This is particularly effective in teaching basic skills, and in helping experienced students master complex materials.

Practicing Applications

Important Finding

Practice promotes learning of new skills.

Lack of Practice

Most education and training programs involve too much in the way of talking, presenting, and demonstrating on the part of the instructor.

Procedural Tasks

With procedural tasks, listening and watching are not good enough if you have the option to doing. Remember that doing requires some initial level of learning.

Key Points

The following key points contribute to successful practice:

- Students learn best by doing and should have opportunities to practice.
- Students should practice a variety of tasks representative of the job.
- Instructors should emphasize key points to increase retention.
- Explicit feedback helps students identify and correct performance difficulties.

Amount of Practice

The amount of practice required to correctly perform a task usually increases with task complexity. In very complex tasks, small segments of a task should be practiced before the entire task.

Removing a jet engine is a complex task which might require practice on individual engine components (task activities) before the engine is actually removed.

Appropriate

Using the wrong learning strategy inhibits learning during practice.

Techniques	Instructors should always use practice techniques appropriate for each task. In seemingly simple tasks such as memorizing strings of digits, students can practice for hours without improving their performance unless a proper learning strategy is used. Grouping or coding schemes ..... may be the best way to learn strings of digits.

Mental Models

Important Finding	**Mental models promote understanding of concepts.**
Mental Model Definition	Learning involves the development of qualitative conceptual structures that are called "mental models." A person uses mental models to understand, explain, and predict things about the world. Mental models allow people to describe a system's structure, explain its present state, and make predictions about future states.
Mental Models Evolve	Mental models evolve naturally through the interaction of the learner and particular environments. Methods can be devised to promote their development as follows: • One way is representing the functionality of the work environment and the devices and equipment in it. Providing external guidance or directions allows the buildup of experience. This coupled with cognitive information will guide performance. • An accurate mental model develops from the way events flow on-the-job, and how devices function and

	can malfunction. This serves as the scheme to guide personal action when new problems are encountered. • Students should describe in detail the steps they are using in performing a task. This will help identify errors. Student competence develops faster and transfers readily to the work environment with this procedure.
Example	As an example, take the task of training the students to solve problems in electric circuits, thermodynamics, or mechanics. By guiding students through the steps, explaining why they are taken, and then having students describe the factors and their interactions as they solve subsequent problems, they learn rapidly and accurately. Instructors can check the accuracy of a student's initial representation of all facets of the problem and provide basic correct solutions.
Conclusion	By concentrating on accurate initial description of the problem, students learn to internalize the procedures as part of their mental model, which they use habitually in approaching problems later on.

Motivating Students

Important Finding	**Learning improves when students set their own goals and determine how to achieve them.**
Student Controlled Learning	Students who believe they control their own learning experience, believe they can handle most training challenges. However, not all students can take charge of their own learning without encouragement and help.
Student Set Goals	Students can learn to set daily goals, monitor progress toward these goals, and chart progress to provide reinforcement. Instructors should always check students' progress and provide positive verbal encouragement and reinforcement.
Focus on Competence	Extrinsic rewards (grades, etc.) may not motivate students as much as goals and rewards based on direct involvement with the ongoing education and training. Instructors should focus attention on the long term competence rather than extrinsic rewards. The following techniques are useful in promoting this focus:

- Provide feedback that informs.
- Encourage persistence in learning.
- Point out instructional relevance.

Rewarding Learning Effort

Instructors frequently reward learner effort so that the learners may concentrate on working hard and fast rather than on the quality of their work.

Instructors Should Emphasize

Instructors should examine their reward system and place more emphasis on the following to encourage effort and performance:

- Instructors should explain, when effort is rewarded, the extent to which the reward is for effort so that students do not confuse an effort award for quality performance.
- Students generally consider the quality of their work when performance is stressed.
- Instructors should be careful in telling students who are failing that the failure is only because of lack of ability. Students who feel they do not have the ability to learn may develop a pattern of hopelessness and stop trying.
- Instructors should help students overcome training obstacles and devote effort to learning if there is any chance the individuals can succeed.

Conclusion

Instructors should focus on motivating their students, and on relevant learning tasks. Less capable students should be rewarded for progress; high achievers should always be challenged according to their abilities.

Student Controlled Learning

Important Finding

Students' perceptions of who controls key events in learning significantly affect their academic achievement.

Student Perceptions	Students generally attribute learning success to a combination of ability, effort, and luck. Students believe if they significantly control learning, they can also organize their environment for maximum success; that is they can "make their own luck."
Student Perceptions of Success	The following points represent student perceptions about success and failure: • Civilian schools have repeatedly demonstrated that in teaching slower students, the students think that other individuals cause their successes and failures. • Successful students are more likely to recognize their responsibility for achievement. • Students' perceptions about who caused their successes and failures depend on situational factors. Certainly instructors can change these perceptions. • Feedback on performance quality and how to improve it can teach slower students to recognize that they are responsible for their learning and performance.

Out-Of-Class Assignments

Important Finding	**Students' performances improve significantly when instructors regularly give out-of-class assignments, ensure they are completed, and provide explicit feedback.**
Students Learn More	Students in courses requiring out-of-class assignments learn more than students in courses without such assignments.
Relevant Out-of-Class Assignments	The time students spend on relevant out-of-class assignments benefits them as much as in-class learning time.

Instructors should always grade assignments to inform students of their performance.

Benefits from Out-of-Class Assignments

The following are benefits from out-of-class assignments:

- Instructors can use out-of-class assignments to increase practice, a technique especially helpful for low achievers.
- Low achievers doing out-of-class assignments often obtain grades as high as students with greater ability who do no extra assignments.
- Out-of-class assignments boost student achievement through increasing total study time.
- Out-of-class assignments can be helpful for all students, but especially for slower students.

Summary

Students are more willing to do assignments they consider useful. Instructors should give the same care in preparing out-of-class assignments as classroom instruction.

Conclusion

Out-of-class assignments must be an integral part of instruction. Evaluate them, and count them as part of the course requirements.

Conclusion to Techniques for Instructors

Excellent Techniques Are Ageless

After looking at what civilian and military research found in the role of the instructor, one can see that some excellent techniques are ageless. We have to remind ourselves that what worked in the past can still work today.

Motivated Instructors Do

We learned in this section that a motivated instructor would help the student in the following ways:

- Bring good practices to bear on education and training.
- Focus classroom activities on learning.
- Emphasize student learning and achievement.

- Monitor students studying and adjust their activities to maximize their effort and progress.
- Give corrective feedback regularly.
- Promote effective use of instructional time in learning.
- Learn and use teaching techniques that enhance student learning.
- Provide well-structured presentations and classroom activities.
- Arrange many and varied learning activities.
- Create a job-like instructional situation.
- Emphasize hands-on, job-like performance tests.
- Test and question students to evaluate their learning progress and maintain motivation to learn.
- Provide students with opportunities for individualized work.
- Design out-of-class assignments to increase student achievement.

Caring about Students

Most of all, right up front, you must **care** about your students, and let them know you are excited about teaching them.

If the students aren't convinced you care, all areas of discussion so far will not matter!

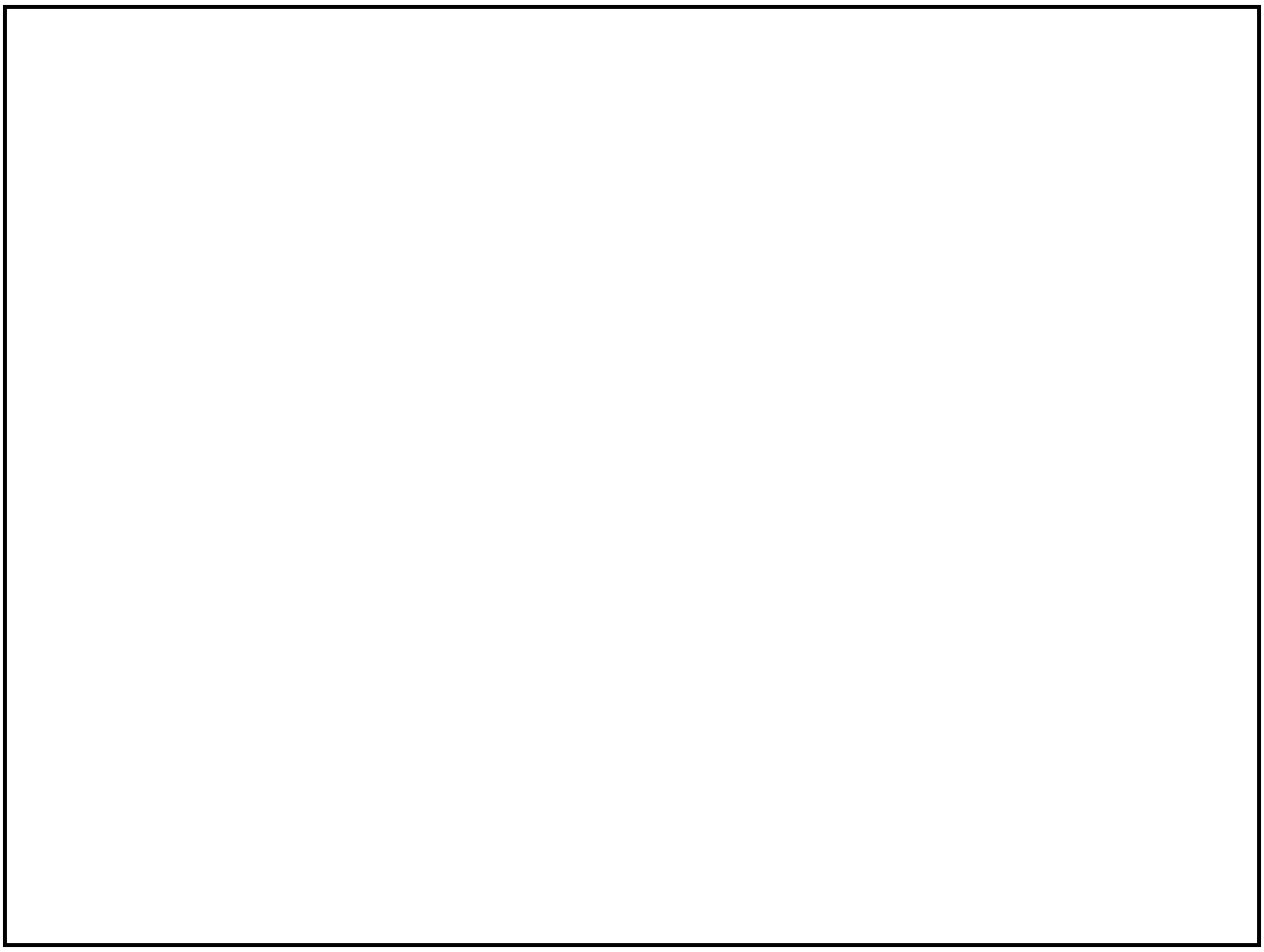
Manager, Instructor, Specialist Are Required

The manager and instructor are clearly important elements to ensure the student learns what is important, and the student feels good about what is learned.

The specialist is the third element needed for the successful delivery of education and training.

Specialist Role

Specialists provide advice and assistance to managers and instructors. They assist with evaluation, course materials design and development. The instructor and specialist may be the same person. Economic realities make this an increasing probability. The next section will focus on what research contributes to the performance of the specialist.



Section C

Techniques for Instructional Specialists

Where to Read About It

The following topical index is provided as a quick reference to this section.

Systematic Instructional Design

Important Finding	**Systematic training design models provide methodologies for planning, analyzing, designing, developing, implementing, and managing instruction and are important for limiting content to that clearly needed.**
System Approach Similarities	System approaches to instructional design all require the same general steps or phases necessary to produce instruction to support the intended learning by students.
Positive Characteristics of System Approaches	System approaches share these positive characteristics: • These system models (refer to AFMAN 36-2234) make sure that every piece of instruction has recognizable elements and is tied to an analysis of needs and tasks to be learned. • They assist the management of training development by making education and training congruent with job-tasks without irrelevant content, evaluating effectiveness and revising inadequate materials, making media development more efficient, promoting efficient use of time, and allowing for structured resource management and planning.
Limited Training in Systems Approach	Quality of training programs applying systems approach models usually depends on the knowledge and skills of personnel using the procedures. Most Air Force instructors receive only brief training in the use of these procedures.

Insufficient Understanding

Insufficient understanding about how learning occurs prevents the development of simple, yet general and useful, theories of how to make it occur.

Until this process is better understood, clear and simple prescriptions for devising instruction will not be available for them to follow.

Air Force Solution

The Air Force is currently attempting to fix this problem of insufficient understanding of how learning occurs by creating "How To" volumes on applying Instructional Systems Development (ISD) to Acquisition, Aircrew Training, Technical Training, Education, and On-The-Job Training (AFH 36-2235, Vols. 3, and 8 through 11).

Instructional Materials Must Be Tested

Because of the different levels of expertise involved in developing instruction, empirical tryouts of the instructional materials and system with students is very important.

Findings in this Volume Are Tested

Many of the research findings in this volume provide useful information for designing instruction. Developers need to become aware of these tried-out results and learn how to incorporate them into the instruction they design and develop.

Navy Instructional Quality Inventory

The Navy, as the Air Force, has developed a tool for reviewing objectives and checking their congruency with associated training and test items called the Instructional Quality Inventory (IQI).

When applied to existing programs, or during the development of new courses, this IQI tool focuses instructional developers on the objectives and course requirements during the development of instructional materials and test items.

	Instructional Objectives
Important Finding	**Objectives which directly reflect education/training requirements are easiest to test. Measurable, observable education/training objectives ensure consistency among job tasks, course content, and test items. When education/training include objectives, student confidence improves and anxiety decreases.**
Objectives Useful for All Content	Objectives may be easier to write for concrete procedures than for more academic content areas such as history. No evidence suggests that objectives are more useful for one content area than another.
Objectives Have Three Elements	Expanding the task statements into objectives requires the following: • Clarifying the behaviors. • Identifying the relevant conditions under which the behaviors are to be displayed. • Specifying standards used to determine adequate performance. Test development is facilitated when objectives contain the above three elements.
	Text Enhancement
Important Finding	**Text enhancement through effective introduction, summaries, examples, and diagrams aids student comprehension.**
Importance of Text	Much education and training is accomplished through written descriptions. Texts are prepared to serve as a basis for student learning by providing facts, examples, and explanations.
Student	To learn, students must understand the materials and how they

Understanding can apply the information.

Reasons for Lack of Understanding Descriptions, instructions, and explanations are often difficult to understand because of terminology, inadequate connections to student knowledge, or a "topic-orientation" that tells all about a subject, but not "what a person does" or "how to do it."

Performance Oriented Writing Writing should be performance oriented rather than topic oriented. Topic oriented writing looks like reference material aimed at a general, unspecified audience, telling all about a subject and not how to apply the information.

Benefits of Performance Oriented Writing Performance oriented writing focuses on specific users; describes their roles, tasks, and responsibilities; and gives them the information they need about how to perform.

The advantage of performance oriented text is that readers do not have to infer and conceptualize what to do; it is stated explicitly.

Writing Techniques to Improve Student Comprehension Techniques for improving text comprehension include:

- Providing pre-presentation summaries outlining learning requirements.
- Inserting pictures showing spatial relationships, object form, or internal structures.
- Using concrete examples clarifying abstract ideas or depicting how principles work.
- Using methods that put demands on the student in reading and "processing" the text.
- Asking questions inserted before or after text segments to identify important information, or make desired inferences.
- Asking students to construct a diagram or "map" depicting the relationship of ideas in text to aid comprehension and remembering the information.

Reading Grade Levels

Important Finding	**Reading grade level scores help in determining how well students understand instructional materials.**
Readability Predicts Recall	Readability formulas predict how well personnel of varying reading ability can recall text they have read or heard.
Limitations of Readability	Readability is of limited usefulness for predicting comprehension of instruction. It is limited because it does not: • Provide precise estimates of difficulty. • Estimate the difficulty of non-text materials such as tables and figures that make up much of the instruction in technical training courses. • Take into account how the materials will be used-- whether they are studied and learned or read while performing. • Take into account students' background knowledge in the area and related areas. Students with a lot of background knowledge can attain high comprehension while having reading ability several grade levels lower.
Issues Other than Readability	Issues other than readability should be considered in developing instruction. Performance oriented text is recommended in manuals over topic orientation. Topic oriented text tells the reader everything one wants to know about the topic, but it does not tell what actions are to be performed. A reader must infer what to do. Surprisingly, technical manuals and texts are often topic oriented. Performance-oriented text explicitly tells the reader what actions are expected.

Building On Existing Knowledge

Important	**Students learn best when instruction is adapted to existing**

Finding	**knowledge, skills, and background.**
Instruction Should Reflect Student Experience	Students can learn much from invaluable life experiences they bring into the classroom. Education and training materials should consider students' existing knowledge and experiences.
Not Critical to Cover Everything Equally	It is not critical for educators and students to cover all topics and subjects equally well. Human energy and time are finite. Trying to master a little of everything may sacrifice efforts to focus on crucial information and issues.
Design Instruction on Entry Behaviors	As instruction is being developed, education and training specialists should reference target population data to determine students' entry knowledge, skills, attitudes, and proficiencies so that instruction can be designed based on entry behaviors.
	Using Examples
Important Finding	**Providing students with good representative examples and contrasting them with bad ones are effective instructional strategies.**
Collect a Variety of Examples	It is necessary to collect a variety of examples that are not ambiguous or confusing.
Illustrate the Task	Illustrate the task so that the student will understand the problem being studied and not acquire misconceptions.
Elements of a Good Example	Each example must be complete and self-contained. Each example should contain the necessary critical features, or attributes so that the student can observe their presence or absence.

	The student should be able to construct adequate generalizations or representations of the tasks from a good example.
Good Example Characteristics	Good examples must possess the following characteristics: • The form and fidelity of each example must adequately represent the critical features of the task. • Examples should be as divergent as possible while belonging to the task being taught. This will prevent the formation of misconceptions. • Examples using extreme variations are avoided. They make examples difficult to understand or demand skills the students may not have. • Easier examples should be provided early in the lesson with a gradual increase in difficulty.
Attention Focusing	Use attention focusing devices to direct student attention to critical features, to confusing features, and to the absence of critical features. Students tend to respond to similar sets of stimuli in similar ways even when the response may be incorrect in one situation.
Focus on Critical Differences	Student discrimination is facilitated by exposing students to good examples paired with appropriate bad examples. Focusing on the critical differences between good and bad examples, so they may be easily identified, will assist the student in better discrimination.
Conclusion	Just as students learn from their mistakes, they learn from good examples and bad examples.

Motivating Students

Important Finding	**When instruction gets the students' attention, students work hard, achieve well, and enjoy learning.**

Four Classes of Factors Influencing Motivation	Four classes of factors influence student motivation to learn and determine their achievement. Including these factors in the design and development of instruction can have beneficial effects on student achievement.
Class One: Exciting Instruction	• Instruction that is attractive and exciting is especially useful to gain students' attention or interest. Instruction should include material that stimulates their curiosity and makes them eager to learn the material.
Class Two: Relevant Instruction	• Students understand the relevance of instruction when objectives are explained to them and new learning is related to their past experience and knowledge. • Presentations need to explain the goals of the instruction, how the knowledge is to be used, and the role students will play in the work assignment when training is finished.
Class Three: Progressive Sequencing	• Providing instruction that allows students to proceed through a sequence of graded steps maximizes the likelihood of learning and develops confidence in their ability to succeed. • Assisting students to solve learning problems because they tend to reduce effort expended in learning when failure is repeatedly experienced. • Presenting simpler materials and problems first, arranging objectives in a progressive, logical sequence, and applying other techniques that facilitate making correct actions or explain adequate behavior--these all motivate behavior.
Class Four: Adequate Feedback	• Praise for accurate performance, and informative feedback work better than threats or negative comments. • Feedback given soon after performance should emphasize what are acceptable aspects of performance. • Information correcting errors or guiding performance may be most useful given just before another opportunity to perform.

Designing Effective Illustrations

Important Finding

Diagrams, graphs, photographs, and illustrations improve student learning.

Benefits of Utilizing Illustrations

The following benefits from utilizing illustrations are:

- Illustrations enhance instructional text and help students remember content.
- Color illustrations encourage students to closely examine materials; color should be used especially to cue what is being learned.

Good Illustrations

Good illustrations should have the following characteristics:

- Illustrations should be as simple as possible to reduce confusion.
- Illustrations should be directly related to the lessons. Those which are not are often more distracting than helpful.
- Illustrations with highlighted or labeled information aids learning by making critical items more apparent.
- Illustrations to show various switches on a complex system is a way of avoiding clutter.

Animation

Animation, which is the use of several visuals in rapid succession to simulate motion, may increase student attention. This technique is useful when the content is not appealing.

Example of Contrasted Illustrations

Two illustrations, taken from Montague and Knirk, are contrasted in figure 5. The valve on the left is cluttered and confusing; it should be simpler and show only those parts necessary for instruction. Irrelevant labeling was removed from the valve on the right to show the most important parts.

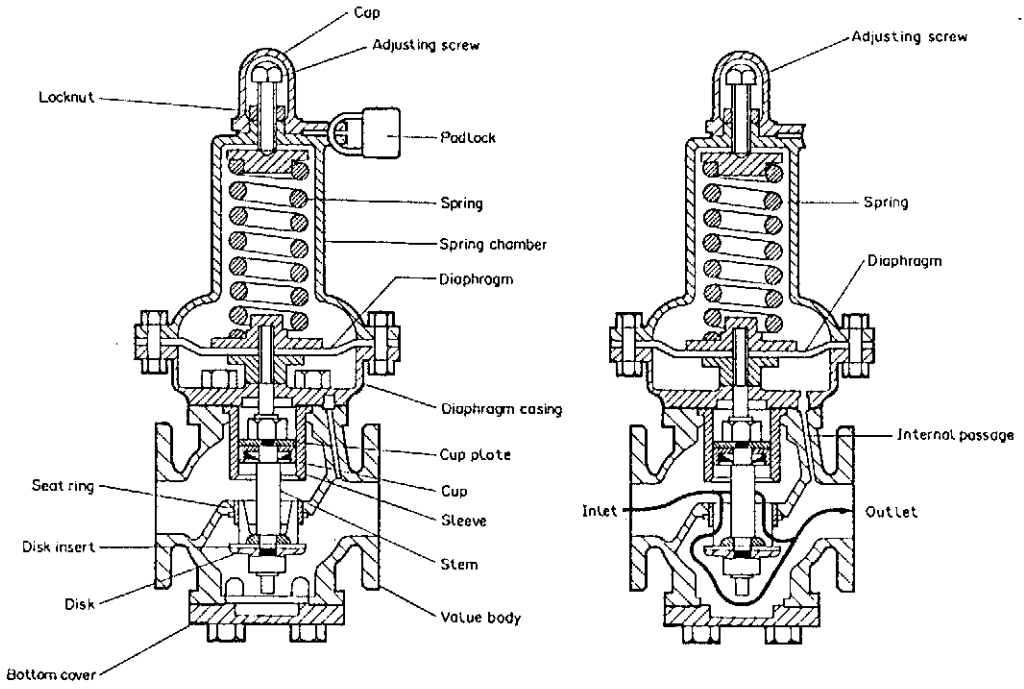


Figure 5. Contrasted Illustrations

Formative and Summative Evaluation

Important Finding	**Trying out instruction determines its overall effectiveness and efficiency.**
Formative Evaluation	Formative evaluation is performed while an instructional program is being developed.

Defined	It identifies and removes the most obvious errors in the instruction, obtains initial reactions to the content from the students, and prevents compounding errors. The evidence collected is used to "form" the instructional program.
Questions Answered in Formative Evaluation	Questions that should be asked during this type of evaluation should identify the students' perceptions of strengths and weaknesses of the instructional materials: • Is the instruction interesting? • Do the students understand what they are supposed to learn? • Are the materials directly related to the stated objectives? • How long do the students take to complete the material provided? Does this confirm planning? This type of student feedback can be extremely useful for the developer.
Summative Evaluation Defined	Summative evaluation, on the other hand, is usually undertaken when instructional development is complete using a larger sample of students. Its purpose is to provide "summed" evidence about how well an instructional program works.

Effective Simulation

Important Finding	**Effective simulation provides systematic practice and feedback about errors, depicts how a device or system works but may violate physical and temporal fidelity.**
Expensive Simulators	Expensive simulators which are physically faithful to actual equipment may not provide as effective training as simple,

not Always Best	part-task trainers which simulate only a few features.
Complex Simulators not for New Students	Complex simulators may inhibit new students from keeping track of tasks, causing them not to see the results of their interactions with the system.
Simulators for New Students	Simulators intended to train new students may need to be designed differently from those intended to train advanced students. New students need extensive, simplified guidance and precise corrective feedback while advanced students may only need to broaden their knowledge and skills.
Simulator Advantages	Simulators offer many advantages in training: • They are often cheaper than actual equipment. • Dangerous critical tasks are best practiced using simulators. • The effectiveness of a simulation results from the instructional methods incorporated into the device that support student learning rather than from the simple physical or functional similarity to an actual device.
Design Decisions	The design decisions are based on ways to isolate, or discriminate cues, and ways to provide time compressed practice for skill development rather than on particular hardware or media.
Analysis Required	Needs and cost-effectiveness analyses must be performed before incorporating simulators into instructional programs.

Effective Testing

Important Finding	**Testing needs to be geared closely to the goals of an education and training program.**
Purpose of Testing	Testing during and after instruction is used to indicate student progress, determine what students find difficult, and tailor individual assignments to overcome the difficulties.
Testing Focused on Performance	The testing should be focused on performance requirements which are derived from analysis of the work trained individuals are expected to do.
Means of Testing	Various means of testing are used, including laboratory exercise performance, oral and written quizzes and tests, out of class assignments, classroom questions, and comprehensive performance tests.
Job Related Assessment	Assessment needs to be as job-like as possible. Performance tests should be hands-on. Pencil and paper tests of knowledge should be restricted to safety and knowledge critical for job performance. If workers use manuals and books to find the information needed to carry out a task on-the-job, open-book testing should be used.

Frequently Tested Students	Well designed, performance oriented tests inform students about job requirements and guide their learning. Frequently tested students out perform less frequently tested ones.
Knowledge and Performance Tests	Students generally take two kinds of tests: knowledge and performance tests. • Knowledge tests help instructors find out if the students have learned information important for safety and knowledge important for performance.

	• Performance tests indicate student competence and provide information about both student and instruction inadequacies.
Prompt Testing and Feedback	Errors that students make on tests and in class identify learning problems that need to be corrected. Instructors need this information to provide prompt feedback to students on their performance and assignments and to help correct any difficulties they may have.
	Instructional Objectives and Tests
Important Finding	**Objectives and tests must correlate with each other.**
Derivation of Objectives	Objectives are derived from the job performance and instructional requirements.
Composition of Tests	Tests should be composed of the behaviors, conditions, and standards referenced in the objectives.
Performance and Knowledge	Performance objectives and tests emphasize hands-on requirements while knowledge objectives and tests focus on information critical to job performance.
	Instructional Time Distribution
Important Finding	**Spacing training over several sessions separated by other activities makes training more effective than masses of concentrated practice.**

Students Absorb	Students can absorb only a limited amount of information at one time.
Designing Shorter Distributive Segments	Training can be made more effective by designing shorter, distributed lesson segments with periods of varied interspersed activities. Drill for certain skill enhancements can be made effective by using short sessions of one particular drill separated by other drill activities.
Distributive Better Than Successive	Two distributed sessions are twice as effective as two successive sessions. Students' achievements following mass practices are not as high as achievements in shorter, distributed sessions.

Promoting Student Cooperation

Important Finding	**Promoting cooperation among students in training facilitates academic achievement.**
Advantages of Promoting Student Cooperation	Some advantages of promoting student cooperation are: • It is more effective than promoting interpersonal competition and individual effort to outshine others in class. • It may also assist subsequent team activities as students learn to work together.

- It promotes positive feelings of personal worth and positive attitudes toward the course content.

Peer Instruction

Arranging peer interaction in small groups to supplement regular classroom and laboratory teaching helps slower and underachieving students to learn and succeed in school.

Forms of Peer Cooperation

Peer cooperation can take a variety of forms:

- Discusssion groups, seminars, or tutorial groups led by teaching assistants.
- The proctor model, where senior students may assist individual students.
- Student learning groups that are instructorless or self-directed, or senior students teaching entering students.

Benefits of Student Coaching

Student coaching is useful in raising achievement in the following ways:

- The coaches benefit because they learn more about the material by preparing and giving lessons to others.
- The effort of coaching usually raises achievement test scores.
- The effects are greatest in long cognitive courses and extensive drill-in-practice courses.
- Short courses that stress test-taking show the least improvement from coaching methods.
- Classes that use tests at the start of the course report stronger coaching effects than classes giving tests only at the end.

Utilizing Life Experiences	Students bring many life experiences into the classroom, which should be acknowledged, tapped and used. They can learn well and much through cooperative study with respected peers.

Memory Aids

Important Finding	**Mnemonic devices or coding systems help students recall important information.**
Minimize Memory Requirements	The most important point to remember in memory learning, especially in the military, is that we need to minimize requirements to memorize. We need to do more to help students test application of knowledge early on.
Rote Memory Inefficient	When faced with memory activities, learning by rote seems an inefficient way of remembering.
Mnemonic Devices Help	When students are faced with a task requiring memory, they often try to devise a scheme to learn the task easier. Teaching students mnemonic procedures aids learning.
Recall Can Be Improved	Individuals can recall short-term a string of seven unrelated items like digits or letters presented to them one at a time. Recall performance can be improved to many times beyond this seven level by using a learning strategy like coding items into more meaningful chunks, and by practicing a lot.
	The figure 6 shows data obtained from two persons who learned a way to increase memory-span to exceptional performance levels (Ericsson & Chase, 1982). The lighter line is that for a person who was read strings of digits and was asked to recall them. He was a runner. Some digit groups reminded him of running times. He coded 3- and 4-digit groups as running times (e.g., 3492 was coded as 3 minutes 49.2 seconds). He constructed other

mnemonic associations such as ages and dates.

The darker line is that for a person who was taught the memorization scheme. He was also a runner.

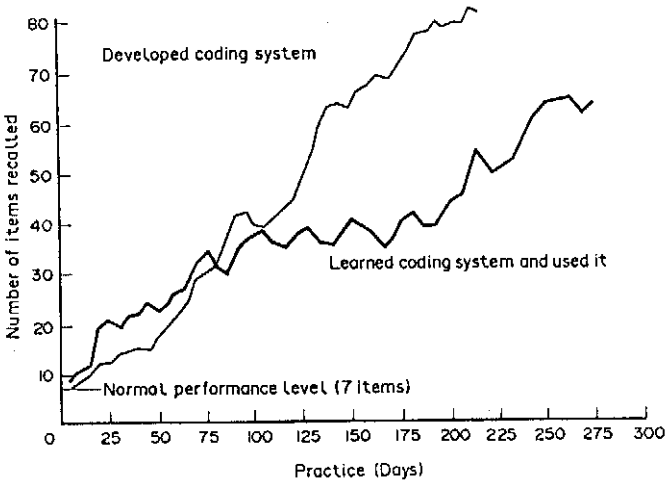


Figure 6. Effectiveness of Cuing

***Conclusion* to Figure 6**

Both runners in figure 6 performed exceptionally. The important point is that coding schemes based on a person's existing knowledge can serve as learning strategies. Good ones can be useful to all learners.

Self-generated Schemes

Self-generated schemes are powerful tools in learning.

Extensive Practice

Extensive practice is necessary to develop skill.

Many Memory Aids

There are many kinds of memory aids. Some formal devices composed of visual images or rhymes provide students mental cuing structures.

Students learn the cuing structures first and associate each item of new information with one or more of the memorized cuing structures.

Cuing Structure

Usually, the cuing structure is not conceptually related to the information it cues. Consider the rhyming peg-word mnemonic system, "One is a bun, two is a shoe, three is a tree, etc. . . ."

Students first memorize the ordered rhymes. Then, when they

must learn an arbitrary set of items in order, they relate the first with "bun", the second with "shoe," and so on. Instructions often suggest using visualization to help relate the items.

Conclusion

Mnemonic devices are effective in helping students recall unorganized names and procedural data.

Conclusion to Techniques for Education/Training Specialists

Similarites between Instructor and Specialist

After looking at the instructional specialist we can see that some areas seem the same as the instructor's concerns which proves that in some environments the instructor is also the specialist.

We should look at the specialist both as a separate and interrelated instructional function depending on the environment.

Expectations for Specialists

By looking at the section as a separate function the instructional specialist now can:

- Become assertive instructional leaders by emphasizing factors that bring about excellence.
- Learn and understand scientific bases from education and training excellence.

- Expect high quality and productivity from staff, instructors, and students.
- Implement and monitor in-service staff training.
- Monitor and evaluate instructors and instruction.
- Promote interaction among instructors.
- Protect instruction from irrelevant demands.
- Develop well-structured, work-like education and training environment to support student learning.
- Adjust training to goals and to students through detailed evaluation of performance.
- Assist instructors in providing feedback to students.
- Monitor development and empirical evaluation of training technologies.
- Analyze and propose improvements in education and training effectiveness and efficiency.
- Provide input to higher management regarding education and training policy.

Section D

Physical Classroom Environment

Important Finding	**Classroom lighting, color, temperature, humidity, and noise levels affect student perception, attention, and achievement.**
Properly Designed	A greater level of learning occurs in a well designed learning environment than in a poorly designed one.
Winter Room Climate	A temperature range of 68-74 degrees F at 30 inches from the floor in the winter is healthful and comfortable. The humidity should be kept between 30-60%.
Sedentary and Active	The maximum temperature for adult learners for sedentary tasks is 85 degrees F and 65 degrees F for active tasks.

Tasks	
Noise	Background noise apparently interferes with learning or concentration in some learners more than with others.
Highest Acceptable Noise Level	The highest level of background noise in a learning environment should not exceed 45 db.
Optimum NoiseLevel	Optimum noise level is 30 db for a learning environment.
Noise Limits	Noise levels above 96db seriously impact student error rates. Noise effects of continuous and intermittent pure tone, and noise at .... fairly low levels of 70dbA, results in a significant decrease of learner performance where high cognitive loading tasks are required.
Graphic Example of Noise Effects	Many experiments were conducted studying the effects of noise on sustained attention. The figure 7 below illustrates the effects of noise on the incidence or errors over time in a serial reaction task lasting 40 min. Precautions to eliminate the effects of acoustic cues were taken which included the use of a silent keyboard and ear defender headphones. .. In both loud (90dbC and soft 60dbC) conditions the noise is switched off at the end of the third quarter.

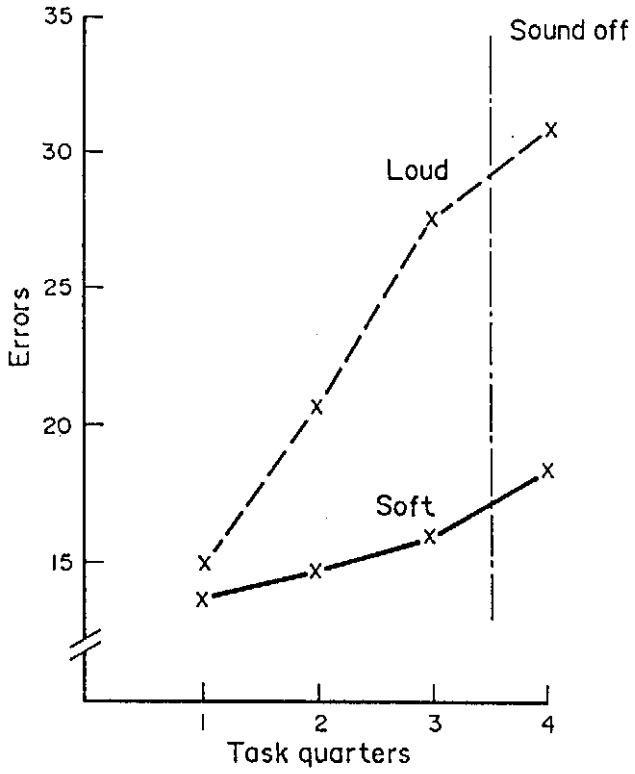


Figure 7. Effects of Noise on Student Error

Lighting Importance

Light levels should be directly related to the viewing difficulty of the learning tasks.

Insufficient illumination, glare, reflectance, shadows, low brightness ..... contrast, and flickering affect human performance.

Good lighting and color decisions increase human performance.

Lighting Levels

Lighting for reading tasks should be at the lighting level of 540-755 lux.

Lighting for bench work should be at the lighting level of 540-1000 lux.

Lighting for learning rooms should be at the lighting level of 500-750 ... lux.

Avoid Lighting Extremes

Extreme light level contrast must be avoided. Constant adaptation of moving from a brightly lit to a darker area can cause eyestrain and headaches.

Biological Effect of Lighting .

Lighting has a profound biological effect on humans. The quantity and quality of light are important.

Natural, full spectrum tubes (as opposed to traditional fluorescent tubes), reduces individual stress and aggression, yet is more intellectually stimulating.

Student Preferences for Lighting

While light level preferences differ among individuals, bright lighting increases achievement for most students.

Students preferring low lighting did better under lower light conditions.

A learning environment should not be uniformly bright and students ..... should be allowed to sit where their light preferences direct them.

Windows?

Data neither consistently support claims that windowless classrooms will .. allow increased concentration and higher achievement, nor the fear that ..... the absence of windows will have harmful psychological or physical effects.

Color Importance

Color influences student learning, attitudes, and behavior. The impact of color on an individual changes with age and with cultural background.

Color directly influences physiology as measured by blood pressure, ... respiratory rate and reaction time.

Color and Time Color has a direct relationship on an individuals sense of time. . Red makes more people overestimate time, while greens and blues in the envrronment cause an underestimation of time.

Bright Colors .. Bright colors (such as red) tend to increase an individuals activity level.

Choosing Colors Types of objectives to be taught in an area should be considered in choosing classroom or study area colors. Some general guidelines for .... choosing colors:

- Classrooms or laboratories: greens, blue-greens, gray, beige.
- Gyms: neutral tones or cool colors.
- Auditoriums: green, aqua, peach.
- Entry areas: pink (also useful in prison holding tanks to quiet prisoners), or neutral tones.

Changing Colors .. Changes in classroom colors can affect learners. Changing the focus area, or changing individual attitudes, in a classroom may also be done by painting the classroom a light neutral color and then using flood- ..... lights to change the setting.

Chapter 3

AUTOMATED TOOLS

Overview

Introduction One of the most frequent suggestions for improving instructional systems is automation. Management information systems which track courseware development have become necessary. This is especially true for producing training for large weapon systems.

Decision Support Decision support tools that assist with such tasks as designing instruction, selecting instructional strategies and media, are vital

Tools to expeditious development of training.

Automated Tools for Instructional Development This section identifies selected automated tools that facilitate Air Force instructional planning, design, development and delivery.

A complete list of tools to assist you in developing a training program can be found in a "Survey of Training Development Software Tools" developed by the Computer-Aided Acquisition and Logistic Support (CALS) Human System Components Committee.

Where to Read about It This chapter contains six sections.

Section A

Guidelines for Transportable Education and Training (GTET)

Date of Software June 1991.

System Requirements CPU, 640Kb RAM, 1Mb hard disk space; a compatible printer capable of providing graphics printout and 132 characters per line text printout; and Lotus 1-2-3, 2.01 or 2.2, and Super Project Expert.

Purpose	GTET assists the training manager in transporting resident courses.
GTET Description	GTET is a result of Joint Service Manpower and Training Development Committee. The system has three components: the GTET model, the GTET Management Information Support System (GMISS), and the GTET Cost Analysis Support System (GCASS).
GTET Model	The GTET model provides a hierarchical set of diagrams depicting project conversion activities.
Top Level Process Model	The Top Level Process Model shows the five sequential project phases -- determining feasibility, evaluating design alternatives, producting prototype course/lesson, producing and finalizing course material and transition.
Functions and Tasks	The next level of the model is the expansion of the phases into functions. The last level of diagrams further expands the functions into tasks. Detailed guidance for managing project activities is provided for the tasks.
GMISS Defined	GMISS is a generic file which is used with commercial project management software, Super Project Expert, to produce a GTET, users apply Super Project Expert to modify the default data in GMISS and produce project schedules and resource allocation reports. The only resources in the default data is the training manager.
GCASS Defined	GCASS is a LOTUS 1-2-3 worksheet containing macro commands. Users enter data from their instructional plan. Input tables are provided for general activity and three educational activities: transmission, presentation, and evaluation. Users can enter up to five alternative plans in a single file for analysis and comparison.

GCASS Output	GCASS then calculates the cost estimates using default cost factors which can be modified by users. GCASS output includes work sheets and graphs of life cycle cost, annual cost flow, and cost drivers.
GTET Scope	The scope of the GTET program is limited to the individual course level. The course must be classroom-oriented (e.g., the program does not apply to the training of complex psychomotor skills). Research and development of specialized or unique hardware or of new educational/training techniques is also beyond the scope of GTET.
Prerequisite Knowledge	To use the system, users must have ISD knowledge and skills, training project management, and experiences in Super Project Expert, and LOTUS 1-2-3. It is unlikely that users will have all these prerequisites. A time investment in learning is required.
Steep Learning Curve	The learning curve of the GTET model is steep because it is a paper-based model. The current system does not provide a tutorial or an on-line version of the model.
GCASS Internal Logic	The internal working logic of GCASS is not transparent and is not documented. This prohibits users from having a deep understanding and confidence in the costing model. Many users may also want to modify the logic to suit their own methods or the local environment. Providing modifiable logic will increase the level of adoption.
Point of Contact	Mr. Robert Denton, AETC/XORE, Randolph AFB TX 78150-4325, DSN: 487-3194, COMMERCIAL: 210-652-3194.

Section B

Training Cost Estimator System (TRACES)

Date of Software	July 1991.
Minimum System Requirements	80286 CPU, Microsoft Excel for Windows.
Purpose	TRACES supports resource allocation decisions.
Origination	TRACES was originally developed by the Institute of Simulation

	and Training, University of Central Florida, for the Defense Training and Performance Data Center (TPDC), in support of Air Training Command (ATC). ATC rewrote this software in EXCEL.
TRACES Defined	Similar to GCASS, TRACES is a spreadsheet costing model for training projects. The model is more detailed than GCASS. More preparation and data are required to use the system. The user interface is well designed. Users are prompted by dialogue boxes to enter data. The mouse and window's graphical user interface are standard parts of the user interface.
TRACES Outcome	Users enter course related specifications and site related specifications into TRACES modules: main, personnel, equipment, supply, and facility. These modules feed data into the report generator module to create reports.
Conclusion	TRACES is a well conceived and well designed program. Similar to GCASS, TRACES' internal working logic is not apparent.
Point of Contact	Mr. Robert Denton, AETC/XORE, Randolph AFB TX 78150-4325, DSN: 487-3194, COMMERCIAL: 210-652-3194.

Section C

Training Analysis Support Computer System (TASCS)

Date of Software	April 1991.
System Requirements	IBM compatible computer with MS DOS 3.0 or greater, 640 RAM, a hard disk with 10MB free space, and a printer.
Purpose	TASCS-C assists in instructional design and development.
Description	Unlike the on-line tools of GTET and TRACES, TASCS is an instructional design tool. It uses a database-oriented approach. The software is written in CLIPPER, a compiler that provides

	a super set of the dBase language.
Database	TASCS is used to build databases of tasks, training objectives, media, and units/lessons. This process is reflected in the main menu which provides choices of task, objective, media, and syllabus analysis.
Creating Task Database	The default data contained in the tool are clearly developed for the Air Force. The first step on using the tool is creating a task database and entering task statements and numbers. The convention of the task numbers indicates their positions in the instructional hierarchy.
Analysis of Job Task Characteristics	After the job tasks are identified, they are analyzed with a set of characteristics which are also used in objectives, media, and syllabus analyses.
Examples of Characteristics	Examples of the characteristics are levels of proficiency, area of operation, reasons for difficulty, mission criticality, and frequency. There are values associated with each characteristic.
Values of Task Characteristics	Although the characteristics are fixed, users can modify the characteristic value. These values are specified for the tasks in the characterization analysis.
Extracting Task Database	Most values of task characteristics for tasks lower in the instructional hierarchy can be automatically collected for higher-order tasks. Once the tasks are characterized, a database of tasks for which training is necessary must be extracted from the master task database.
Filtering Rule	TASCS provides a filtering rule to perform the extraction automatically. The rule uses task characteristics such as criticality and difficulty for criteria. Users can also make up

	their own rules.
Objective Database	The tasks selected for training are used to create an objective database.
Objectives Analysis	Steps in the next stage, objectives analysis, are similar to those in task analysis. Task statements become behavioral statements of corresponding objectives. A hierarchy number field, a condition field, and a standard field are also provided for each objective record.
Editing Values	Values of task characteristics for training are carried over to corresponding objectives. These values can be edited, and new characteristics, instructional methods and evaluation methodology, are provided for objectives. No default values exist for these two characteristics.
Objectives Characterized	Most characteristics values for lower-order objectives can also be collected for higher-order objectives. After the objectives are characterized, they are ready for syllabus analysis.
Media Analysis	The third term on the main menu, media analysis, does not have to be specific to a program. The purpose of the analysis is to give media attributes weights which are used in an automated selection of media for training. For each medium, users can assign attributes to each characteristic's value.
Syllabus Analysis	Syllabus analysis is the last phase of the TASCS process. Each objective's database can be converted into at least nine syllabus databases. A lesson is created for each second-level objective; lessons supporting the same first-level objective form a unit.
Syllabus Report	TASCS generates various tasks, objectives, and syllabus reports to aid the instructional design process. The final product, the syllabus report, lists such items as objectives, time to train, media, instructional methods and strategies, evaluation methods, and

proficiency levels.

Does Two Things

Beyond being an information organization tool, TASCS does two things for instructional designers automatically:

- Keeps track of the hierarchical structure of objectives.
- Selects tasks that require training.

Tool Designed for Air Force

Although certain default data are modifiable, many factors are fixed. The number and type of characteristics cannot be changed. The tool is most useful for people who use the instructional design model underlying the program.

Limited Usefulness

The usefulness for others is limited. The characteristics are designed for Air Force operations. Air Force trainers may find the tool particularly useful.

Point of Contact

Mr. Robert Denton, AETC/XORE, Randolph AFB TX 78150-4325, DSN: 487-3194, COMMERCIAL: 210-652-3194.

Section D

Joint Service ISD Logistics Support Analysis Record

Decision Support System (JS ISD/LSAR DSS)

Date of Software	September 1990.
System Requirements	8088 CPU, 640 Kb RAM, CGA color monitor with 256 Kb graphics memory board, MS DOS 3.0, hard disk, 5.25” low density floppy disk drive. At least one IBM-compatible dot matrix printer with 132-column printout and IBM extended graphics set.
Database File Server	80286 microprocessor, 2 MB RAM, DOS emulation (NET-BIOC), 200 MB hard disk, network host links to workstations. (Work-stations in a LAN environment must have network interface cards and software.)

Purpose	JS ISD/LSAR DSS assists in instructional design and development.
Description	The ISD/LSAR DSS is written in the C programming language. The fundamental design of the DSS is using databases to help training professionals perform LSAR and ISD analyses to make training decisions.
TRANSFORM	A fundamental feature of the DSS is its interface with and use of LSAR data. The precursor of this approach is found in the Training System for Maintenance (TRANSFORM) procedure developed by the 3306th Training Development and Evaluation Squadron (TDES) at Edwards Air Force Base, California. TRANSFORM became a subset of the Joint Service ISD/LSAR DSS ISD procedures.
Task Selection Models	Another significant feature of the DSS is that it accommodates several different task selection and media selection models. The supported task selection models are Sub Task Analysis Model (STAM), Difficulty, Importance and Frequency Model (DIF), Early Comparability Analysis Model (ECA), Eight Factor Model, and Four Factor Model.
Media Selection Models	The supported media selection models are Sub Task Analysis Model (STAM) and Automated Instructional Media Selection Model (AIMS). This flexibility allows the tool to be used by different services.
DSS Routines	The DSS consists of LSAR data input routines and Joint Service ISD analysis processes. The system includes utility functions that provide system security, database administration, report generation, and ISD analysis functions.
User Categores	The procedures classify users into five categories: • Database Administrator • Training Development Manager • ISD Analyst

	• Quality Assurance Reviewer • Reference File Maintainer
DSS Facilitates Categories	The DSS facilitates each user category except the reference file maintainer, whose work is done manually. Except for the database administrator, each user category has both administrative and ISD analysis responsibilities. The same person can be in more than one user category. Depending on which category a user assumes when using the DSS, the system makes available the functions that are applicable to the category.
Top Down Procedures	The procedures are a top-down approach that starts from a weapon system to tasks and down to learning objectives.
Procedural Stages	At different stages of the procedures, users analyze a weapon system in the following sequence: weapons system, subsystems and associated skill specialties, tasks, task elements, terminal objectives and enabling learning objectives.
Process Ensures	During this elaborative process, training personnel are assigned responsibility for the items at different levels. The process ensures needed training components for a weapon system are covered.
Importing Data	A large proportion of data needed for analysis can be imported for LSAR. If the LSAR data are not available, users can also enter the data directly into DSS.
DSS Supports ISD Functions	The DSS supports a number of ISD functions. With the help of automated logic, users select tasks that require training, select instructional settings and training media, sequence instruction. and identify training equipment fidelity requirements.

Data for Training Decisions

The DSS presents LSAR and other analysis related data, previously entered or generated by the system, to users for making training decisions. Context sensitive help is available throughout this software.

Overwriting

Users can overwrite LSAR and DSS decisions. The DSS allows users to document their rationale for overwriting decisions. Quality Assurance Reviewers are encouraged to pay particular attention to these decisions.

Automated Work Sheets

The DSS documents all analyses on automated work sheets. Users can print various work sheets for quality control, communication, and documentation purposes. Examples of worksheets are task instructional setting report, course outline report, and task element report.

DSS is Sophisticated and Flexible

The ISD/LSAR DSS is specifically designed to meet maintenance training development for large-scale weapon system acquisition projects.

Without an automated tool, it is a mind-boggling task to manage and perform the training requirement analysis of a sophisticated weapon system. The DSS is a good tool for dealing with this problem.

Point of Contact

Mr. Frank Goddard, DRC, Commercial: 508-658-6100, extension 1668. For site licenses: Dr. Barbara Sorenson, Armstrong Laboratory, ... Brooks AFB TX 78235-5000, DSN 240-3648, Commercial 512-536-3648.

Section E

Guided Approach For An Instructional Design Advisor (GAIDA)

Date of Software	April 1992.
Minimum System Requirements	80386 CPU, 2Mb RAM, 20Mb disk space, MS DOS 3.3+.
Purpose	GAIDA develops prototype lessons for each of the following types of tasks: • Identifying objects and equipment parts • Executing procedures • Recalling procedures • Detecting faults • Troubleshooting • Describing the gist of printed text • Choosing actions reflecting attitude

Appropriate Prototypes	By using the appropriate prototypes, the instructional designer will be able to adapt them to a variety of specific tasks having the same characteristic learning outcomes.
Paper Prototype	A complete paper prototype of GAIDA was developed and evaluated by Air Force training specialists with appraisals indicating practical feasibility and promise of usefulness.
Authors Interactive Courseware	The initial GAIDA prototype was programmed in ToolBook and is currently being evaluated. Initital results indicate that Air Force training specialists (instructional designers) can use GAIDA effectively to author interactive courseware lessons.
Point of Contact	Dr. Michael Spector, AL/HRTC, Brooks AFB TX 78236-5000, DSN: 240-2981, Commercial: 210-536-3648.

Section F

Instructional System Development Automation (ISDA)

Date of Software	April 1992.
System Requirements	80286 CPU, 512 Kb RAM, MS DOS, 2.0 or higher, hard disk (required disk space depends on the size of the data files).
Purpose	ISDA assists in the instructional design and development processes.
Description	ISDA addresses the problem of labor intensiveness by eliminating repetitive data input, filtering out non-training requirements early in the analysis process, and automating report generation.
Input Data	The analyst input data from any source, i.e., Logistic Support Analyses (LSA), technical manuals, etc. This information is broken down into sequential activities and analyzed. The software uses embedded decision logic to pull forward only those activities that require further analysis.

System Generated Reports	The system generates a variety of reports, from task and duty lists to hardware and Computer Based Training (CBT) fidelity analysis documentation. These reports consume a considerable amount of consolidation effort under the paper analysis methodology.
Embedded Decision Logic	ISDA addresses the problem of a lack of standardized analysis parameter application by using embedded decision logic to assist the analyst in making training decisions.
System Prompts Questions	The system prompts the analyst with questions at the task activity, knowledge and skilled behavior, media, hardware, and Computer Based Training fidelity analysis levels. The analyst's answers to these questions provide the relevant information that the system uses to baseline decisions.
602nd TSS ISD Model	A significant part of the 602nd Training Support Squadron's mission is to determine maintenance training requirements for new or highly modified weapon systems. They present this 15 step adaptation of the ISD model: • Step 1 - Identify System Maintenance Requirements • Step 2 - Identify Characteristics of the Target Population • Step 3 - Determine Task-Based Training Requirements • Step 4 - Determine Concept-Based Training Requirements • Step 5 - Determine Media and Methodology • Step 6 - Develop Instructional Strategies • Step 7 - Identify Requirements of Hardware Components • Step 8 - Identify Fidelity Requirements of Computer Based Training (CBT) • Step 9 - Select Instructional Features • Step 10 - Prepare ISD Derived Training Equipment Specifications • Step 11 - Prepare Course Control Documents • Step 12 - Prepare Instructional Materials • Step 13 - Validate Instruction • Step 14 - Conduct Training • Step 15 - Evaluate Training

602ndTSS Automated ISD Process	ISDA software is designed to automate the 602nd TSS ISD process through Step 9, "Select Instructional Features." ISDA generated reports are included in the training equipment functional specifications. The ISDA reports form the basis for course control documents.
Successful Applications	Previous releases of ISDA were successfully used for maintenance training development for the Joint Surveillance Target Attack Radar System (Joint Star) and B-2 programs.
Decision Logic	The decision logic used in ISDA was also incorporated into the Joint Service ISD Logistics Support Analysis Record Decision Support System (JSISD/LSAR DSS) referenced earlier in this section. This is a project sponsored by the Armstrong Laboratory aimed at automating the LSA data flow into the ISD process.
Point of Contact	MSgt Samuel D. Howard, 602nd Training Support Squadron/TSD, 118 South Wolfe Ave., Edwards AFB California, 93524-6545, DSN: 527-3403, Commercial: 805-277-3403.

Section G

Training Systems Requirements Analysis (TSRA)

Date of Software	May 1993
System Requirements	Any computer used should be an IBM PC, XT, AT or an IBM compatible system with a minimum of 384 kilobytes (KB) of random access memory (RAM). A Digital Operating System (DOS) version 2.0 or greater is required. Any color or monochrome monitor is acceptable. The computer should have a floppy disk drive (3 1/2 inches) and an internal access drive (i.e. hard disk) with at least 17 MB of available disk space (for the CISTOMS C application package and two complete databases). A printer is optional.
Purpose	This program provides a Training Sytem Requirements Analysis (TSRA) for the Air Force Primary Aircraft Training System (AFPATS) Ground Based Training System (GBTS).
TSRA Process Defined	The TSRA process utilizes a front-end Training Requirements Analysis (TRA) following Instructional Systems (ISD) guidelines.
Reports	Three TRA reports are produced: Mission/Task Analysis Report,

Produced	Training Requirements Analysis Report, and Objective Media Analysis Report. The TRA data is used to generate a Training Systems Basis Report (TSBAR). Adhering to TSRA processes, the TSBAR integrates the TRA reports and other special analyses to produce an AFPATS GBTS concept.
GBTS Components	The GBTS components are described in the Systems Components Characteristics Document.
Complete Process Produces	This complete process produces course syllabi for the Air Force Primary Aircraft Training System (AFPATS) Specialized Undergraduate Pilot Training (SUPT) and Pilot Upgrade Training/Pilot Instructor Training (PUT/PIT).
CISTOMS-C	This CISTOMS-C Manual contains the User's Guide (Vol I) and Master Programs (Vol 11). Volume I contains guidance to generate reports and update the AFPATS databases for AFPATS end-users. Volume II contains program file descriptions, source code, and master database file structures.
Description	A computerized database and associated analysis tools facilitate the accomplishment of the TSRA to ensure accurate and complete data traceability to source materials. The tools also allow analysts to systematically identify key data components, interrelationships, and requirements for the AFPATS Student Pilot (SP) and Instructor Pilot (IP) trainees.
Training Requirements Described	The training requirements described by this TSRA are designed to assist the Air Force in the development and acquisition of a complete training system.
Systematic Approach	This system approach to training analysis begins with task identification and continues through the production of syllabi required to support those tasks.

The process develops Job Performance Requirements (JPRs) and identifies training requirements including skills, knowledges, and attitudes for the target population.

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BY ORDER OF THE SECRETARY OF THE AIR FORCE

OFFICIAL RONALD R. FOGLEMAN, GENERAL, USAF

Chief of Staff

KEVIN A. COLINS, Colonel, USAF
Director of Information Management

Attachment A - Air Force ISD Documents

AFPD 36-22, Military Training

AFI 36-2201, Developing, Managing, and Conducting Military Training

AFI 36-2301, Professional Military Education

AFMAN 36-2234, Instructional System Development

AFMAN 36-2236, Handbook for Air Force Instructors

AFH 36-2235, Information for Designers of Instructional Systems (11 volumes)

- Vol 1, Executive Summary
- Vol 2, ISD Automated Tools/What Works
- Vol 3, Application to Acquisition
- Vol 4, Guide to Training Technologies
- Vol 5, Interactive Courseware (ICW) Design, Development and Management
- Vol 6, Guide to Needs Assessment
- Vol 7, Design Guide for Device Based Aircrew Training
- Vol 8, Application to Aircrew Training
- Vol 9, Application to Technical Training
- Vol 10, Application to Education

Vol 11, Application to Unit Training

Attachment B - Category Bibliography

Montague, W.E., (1988). What Works: Summary of Research Findings with Implications for Navy Instruction and Learning, NAVEDTRA 115-1. Navy Personnel Research and Development Center (NPRDC), San Diego CA.

Managing the Education/Training Environment

Corcoran, T. (1985). Effective secondary schools. In R. Kyle (Ed.), Reaching for excellence: An effective schools sourcebook (pp. 71-97). Washington DC: U.S. Government Printing Office.

Doyle, W. (1985). Effective secondary school practices. In R. Kyle (Ed.), Reaching for excellence: An effective schools sourcebook (pp. 55-70). Washington DC: U.S. Government Printing Office.

Edmonds, R. (1982). Programs of school improvement. Educational Leadership, 40 (3), 4-11.

Glidewell, J., Tucker, S., Todt, M., & Cox, S. (1983). Professional support systems: The teaching profession. In A Nadler, J. Fisher and B. DePaula (Eds.), New directions in helping (pp.189-210). New York: Academic Press.

Little, J.W. (1982) Norms of collegiality and experimentation. American Educational Research Journal, 19 (3), 325-340.

Walberg, H.J., & Anderson, G.J. (1968). Classroom climate and individual learning. Journal of Educational Psychology, 59 (6), 414-419.

Managing Instructors

Bird, T., & Little, J.W. (1985). Instructional leadership in eight secondary schools (Final Report to the U.S. Department of Education, National Institute of Education). Boulder CO: Center for Action. (ERIC Document N. ED 263 694)

Carmine, D.R., Gersten, R., & Green, S. (1982, December). The Principal as an instructional leader: A second look. Educational Leadership, 40 (3), 47-50.

Corcoran, T. (1985, May). Effective secondary schools. In R. Kyle (Ed.), Reaching for excellence: An effective schools sourcebook (pp. 82-85). Washington DC: U.S. Government Printing Office.

Morris, V.C., Crowson, R., Hurwitz, E., & Porter-Gehrie, C. (1986). Principals in action: The reality of managing schools. Columbus, OH: Charles E. Merrill Publishing Co. Cited in What Works: Research about Teaching and Learning, (2nd., p. 64). Washington, DC: U.S. Department of Education.

Skinner, B. F. (1984). The shame of American education. American Psychologist, 39 (9), 947-954.

Evaluating and Supervising Instructors

Cohen, P.A. (1981). Effectiveness of student-rating feedback for improving college instruction: A meta-analysis of findings. Research in Higher Education, 13, 321-341.

Fielding, G.D., & Schalock, H.D. (1985). Promoting the professional development of teachers and administrators. Eugene OR: ERIC Clearinghouse on Educational Management.

Natriello, G. (1984). Teacher's perceptions of the frequency of evaluation and assessments of their effort and effectiveness. American Educational Research Journal, 21 (3), 579-595.

Natriello, G.,, & Dornbusch, S.M. (1981). Pitfalls in the evaluation of teachers by principals. Administrator's notebook, 29 (6), 1-4.

Skinner, B.G. (1984). The shame of American education. American Psychologist, 39 (9), 947-954.

Wise, A.E. (1984). Teacher evaluation: A study of effective practices. Santa Monica CA: Rand Corporation.

Managing Student Learning

Hill, H. & Sticht, T. (1980, September). Perspectives on battalion training management. (Final Report for USAREUR Field Unit). Alexandria VA: Human Research Organization.

Kern, R. (1986). Modeling information processing in the context of job training and work performance. In T. Sticht, F. Chang, & S. Wood (Eds.), Cognitive science and human resources management (Advances in reading/language research, vol 4). Greenwich CT: JAI Pres.

Morgan, M., Hall, D.T., & Martier, A. (1979). Career development strategies in industry: Where are we and where should we be? Personnel, 56 (2), 13-31.

Monitoring and Tailoring
Cooley, W.W. (1983, June/July). Improving the performance of an educational system. Educational Researcher, 12 (6), 4-12.

Cooley, W.W., & Lohnes, P.R. (1976). Evaluation research in education: Theory, principles, and practice. New York: John Wiley & Sons.

Walberg, H.J. (1984, May). Improving the productivity of America's schools. Educational Leadership, 41 (8), 19-36.

Evaluation and Revision
Cronbach, L.J. (1963). Course improvement through evaluation. Teacher College Record, 64, 672-683.

Ellis, J.A., Knirk, F.G., Taylor, B.E., & McDonald, B.A. (1987). The Course Evaluation System. (NPRDC TR 87-19), San Diego CA: Navy Personnel Research and Development Center.

Markle, S.M. (1967) Empirical testing of programs. In P.C. Lange (Ed.), Programmed Instruction: The sixty-sixth yearbook of the national study of education, Part II. Chicago: University of Chicago Press.

Merrill, M.D., Reigeluth, C.M., & Faust, G.W. (1979). The instructional quality profile: A curriculum evaluation and design tool. In H.F. O'Neil Jr. (Ed), Procedures for instructional systems development (pp. 165-202). New York: NY, Academic Press.

Montague, W.E., Ellis, J.A., & Wulfeck II, W.H. (1983). Instructional quality inventory: A formative evaluation tool for instructional development. Performance and Instruction Journal, 22 (5), 11-14.

Imitating the Job Environment
Prosser, C.A., & Quigley, T.H. (1949). Vocational education in a democracy. Chicago IL: American Technical Society.

Sticht, T.G., (1987). Functional context education workshop resource notebook. San Diego CA: Applied Behavior and Cognitive Sciences, Inc.

Sticht, T.G., Armstrong, W.B., Hickey, D.T., & Caylor, J.S. (1987). Cast off youth: Policy and training methods from the military experience. New York: Praeger.

Walberg, H.J. (1984,May). Improving the productivity of Maerica's schools. Educational Leadership, 41 (8), 19-36.

Maintaining Skills and Knowledge

Bahrick, H.P. (1979). Maintenance of knowledge: Questions about memory we forgot to ask. Journal of Experimental Psychology, 108 (3), 296-308.

Farr, M.J. (1986). The long-term retention of knowledge and skills: A cognitive and instructional perspective (IDA Memorandum Report MR-205). Alexandria VA: Institute for Defense Analysis.

Hagman, J.D., & Rose, A.M. (1983). Retention of military skills; A review. Human Factors, 25 (2), 199-213.

Welzel, S.K., & Montague, W.E. (1983, March). Conditions influencing skill deterioration: A survey of three Navy sonar communities (NPRDC SR 83-18). San Diego CA: Navy Personnel Research and Development Center.

Student-Instructor Ratio

Bozzomo, Lawrence L. (1978). Does Class Size Matter? National Elementary Principal, 57 (2), 78-81.

Glass, G.V., Cahen, L.S., Smith, M.L., & Filby, N.N. (1982). School class size: Research and policy. Beverly Hills CA: Sage.

Williams, D.D., Cook, P.F., Quinn, B., & Jensen, R.P. (1985). University class size: Is smaller better? Research in Higher Education, 23 (3), 307-18.

Managing Informal Learning

Hall, D.T., & Fukami, C.V. (1979). Organization design and adult learning. Research in Organizational Behavior, 2, 125-167.

Hill, H., & Sticht, T. (1980). Perspectives on battalion training management (Final report, USAREUR Field Unit). Alexandria VA: Human Resources Research Organization.

Kern, R. (1986). Modeling information processing in the context of job training and work performance. In T. Sticht, F. Chang, & S. Wood (Eds.), Cognitive science and human resources management (advances in reading/language research, Vol 4). Greenwich CT: JAI Press.

Morgan, M., Hall, D.T., & Martier. A. (1979). Career development strategies in industry: Where are we and where should we be? Personnel, 56 (2), 13-31.

Rogoff, B., & Lave, J. (1984). Everyday cognition: Its development in social context. Cambridge MA: Harvard University Press.

Cost Effectiveness

Bergman, R.E. (1981). Technology and training: The shape of tomorrows seminar. Performance and Instruction, 20 (9), 4-12.

Kearsley, G. (1984). Training and Technology: A handbook for HRD professionals. Reading MA: Addison-Wesley Publishing Co.

Knapp, M.I., & Orlansky, J. (1983, November). A cost element structure for defense training (IDA Paper P-1709). Alexandria VA: Institute for Defense Analysis.

Orlansky, J., & String, J. (1981, Second Quarter). Computer-based instruction for military training. Defense Management Journal, 46-54.

Walberg, H.J.(1987, April). Curricular efficiency can be attained. National Association of Secondary School Principals Bulletin, 71 (498), 15-21.

Planning for Change

Knapp, M.LI, & Orlansky, J. (1983, November). A cost element structure for defense training (IDA Paper P-1709). Alexandria VA: Institute for Defense Analysis.

Orlansky, J., & String, J. (1981, Second Quarter). Computer-based instruction in military training. Defense Management Journal, 18, 46-54.

Niemiec, R.P., & Walberg, H.J. (1987). Comparative effect of computer-assisted instruction: A synthesis of reviews. Journal of Educational Computing Research, 3, 19-37.

Structuring Instruction

Fishburne, R.P., & Mims, D.M. (1975, March). Formative evaluation of an experimental BE/E program (Research Branch Report 9-75). Naval Air Station Memphis Millington, TN: Chief of Naval Technical Training.

Kulik, C.C., Schalb, B.J., & Kulik, J.A. (1982). Programmed instruction in secondary education: A meta-analysis of evaluation findings. Journal of Educational Research, 75 (3), 133-138.

Orlansky, J. & String, J. (1981, Second Quarter). Computer-based instruction for military training. Defense Management Journal, 46-54.

Walberg, H.J. (1984, May). Improving the productivity of America's schools. Educational Leadership, 41 (8), 19-36.

Computer-based Instruction/Training (CBI/CBT)

Hassellbring, T. (1986). Research on the effectiveness of CBI: A review. International Review of Education, 32, 313-324.

Kulik, W.E., & Kulik, C.C. (1987). Review of recent research literature on computer-based instruction. Contemporary Educational Psychology, 12 (5), 220-230.

Montague, W.E., & Wulfeck II, W.H. (1984). Computer-based instruction: Will it improve instructional quality? Training Technology Journal, 1 (2), 4-19. Also, NPRDC TR 84-54, San Diego, CA: Navy Personnel Research and Development Center. (AD-A146269).

Niemiec, R.P., & Walberg, H.J. (1987). Comparative effects of computer-assisted instruction: A synthesis of reviews. Journal of Educational Computing Research, 3 10-37.

Orlansky, J. (1983). Effectiveness of CAI: A different finding. Electronic Learning, 3 (1), 58-60.

Orlansky, J., & String, J. (1981, Second Quarter). Computer-based instruction for military training. Defense Management Journal, 46-54.

Orlansky, J, & String, J. (1979, April). Cost-effectiveness of computer-based instruction in military training (IDA Paper P-1375). Alexandria, VA: Institute for Defense Analyses.

Video Technologies

Bergman, R.E. (1981, November). Technology and training: The shape of tomorrow's seminar. Performance and Instruction, 20 (9), 17-20.

DeBloois, M. and others, (1984). Effectiveness of interactive videodisc training: A comprehensive review. The Monitor Report Series, 1-80. (ERIC Document No. ED 278370).

Fleming, M.L. (1987). Displays and communication. In R.M. Gagne (Ed.), Instructional Technology: Foundations (233-260). Hillsdale, NJ: Erlbaum Associates.

Hassett, J., & Dukes, S. (1986, September). The new employee trainer: A floppy disk. Psychology Today, 30-36.

Nugent, G.C. (1987). Innovations in telecommunications. In R. M. Gagne (Ed.), Instructional technology: Foundations (261-282). Hillsdale, NJ: Erlbaum Associates.

Smith, E.E. (1987). Interactive video: An examination of use and effectiveness. Journal of Instructional Development, 10 (2), 2-10.

Training Devices for Task Simulation & Practice

Blaiwes, A.S., & Regan, J.J. (1986). Training devices: Concepts and progress, In J.A. Ellis (Ed.), Military contributions to instructional technology (pp. 83-170). New York: Praeger Publishers.

Caro, P.W., Shelnutt, J.B., & Spears, W.D. (1981). Aircrew Training Devices Utilization (AFHRL-TR-80-35). Wright Patterson Air Force Base OH: Logistics and Technical Training Division.

Halff, H.M., Hollan, J.D., & Hutchins, E.L. (1986). Cognitive science and military training. American Psychologist, 41 (10), 1131-1139.

Orlansky, J. & String, J. (1981). Cost effectiveness of maintenance simulators for military training (IDA Paper P-1568). Alexandria VA: Institute for Defense Analysis. (ERIC Document No. ED 212 254)

Prophet, W.W., Shelnutt, J.B., & Spears, W.D. (1981). Simulator training requirements and effectiveness study (STRES). Wright Patterson Air Force Base OH: Logistics and Technical Training Division.

Schneider, W., Vidulich, M., & Yeh, Y. (1982). Training s
spatial skills for air-traffic control. Proceedings of the Human Factors Society, (10-14).

Distributed Learning (i.e. Teleconferencing)

Bergman, R.E. (1981), Technology and training: The shape of tomorrow's seminar. Performance and Instruction, 20 (9), 17-20.

Levin, J.A., Riel, M., & Miyake, N., & Cohen, M. (1987). Education on the electronic frontier: Teleapprentices in globally distributed educational contexts. Contemporary Educational Psychology, 12 (3), 254-260.

Newman, D. (1987). Local and long distance computer networking for science classrooms. Educational Technology, 27 (6), 20-23.

Adopting Training Innovations

Margulies, N., et.al. (1973). Organizational Change: Techniques and Applications. Glenview IL: Scott, Foresman.

Nelson, M., & Sieber, S.D. (1976). Innovations in urban secondary schools, School Review, 84 (2), 213-31.

Rogers, E. (1983). Diffusion of innovations (2nd ed.). New York: Free Press.

TECHNIQUES FOR INSTRUCTORS

Ratings

Cohen, P.A. (1981). Effectiveness of student-rating feedback for improving college instruction: A meta-analysis of findings. Research in High Education, 13, 321-341.

Cohen, P.A. (1981). Student ratings of instruction and student achievement: A meta-analysis of multisection validity studies. Review of Educational Research, 51, 281-309.

McKeachie, W. (1978). Teaching tips: A guidebook for the beginning college teacher (7th ed.). New York: Heath.

Classroom Role
Brophy, J.E. (1981). Teacher praise: A functional analysis. Review of Educational Research, 51, 5-32.

Good, T.L., & Brophy, J.E. (1984). Looking in classrooms. New York: Harper and Row.

Shuell, T.J. (1980). Learning theory, instructional theory, and adaptation. In R.E. Snow, P-A. Federico, and W. E. Montague (Eds.), Aptitude, learning and instruction: Vol. 2, Cognitive process analyses of learning and problem solving (pp. 277-302). Hillsdale NJ: Lawrence Erlbaum Associates.

Shuell, T.J. (1986). Cognitive conceptions of learning. Review of Educational Research, 56 (4), 411-436.

Snow, R.E. and Lowman, D.F. (1984). Toward a theory of cognitive aptitude for learning from instruction. Journal of Educational Psychology, 76, 347-376.

Classroom Leadership
Brophy, J.E. (1985). Classroom management as instruction: Socializing self-guidance in students. Theory Into Practice, 24 (4), 233-240.

Cohen, M. (1982). Effective schools: Accumulating research findings. American Education, 18 (1), 13-16.

Gold, M. & Mann, D. (1984). Expelled to a friendlier place: A study of effective alternative schools. Ann Arbor MI: The University of Michigan Pres.

Zemke, R. & S. (1981, June). 30 things we know for sure about adult learning. Training/HRD, 18 (6), 45-52.

Teaching Students How To Learn
Dansereau, D.F., Brooks, L.W., Holley, C.D., & Collins, K.W. (1983). Learning strategies training: Effects of sequencing. Journal of Experimental Education, 51(3), 102-108.

Dansereau, D.F. (1985). Learning strategy research. In J. Segal, S. Chipman, & R. Glaser (Eds.), Thinking and learning skills; Vol. 1: Relating instruction to research (pp. 209-240). Hillsdale NJ: Erlbaum Associates.

Dobrovolny, J.L., McCombs, B.L., & Judd, W.A. (1980, March). Study skills package: Development and evaluation (AFHRL-TR-79-43). Brooks AFB TX: Air Force Human Resources Laboratory.

Montague, W.E. & Knirk, F.G. (1993). What works in adult instruction: The management, design and delivery of instruction. International Journal of Educational Research. Vol 19, pp 327-443, 1993.

Weinstein, C.E., & Mayer, R.E. (1986). The teaching of learning strategies. In M.C. Wittrock (Ed.), Handbook of research on teaching (3rd Edition). New York: Macmillan Publishing Company.

Weinstein, C.E., Zimmermann, S.A., & Palmer, D.R. (1988). Assessing learning strategies: The design and development of LASSI. In C.. E. Weinstein, E.T. Goetz, and P.A. Alexander (Eds.), Learning and study strategies: Issues in assessment, instruction, and evaluation. 25-40 San Diego CA Academic Press.

Testing

Bangert-Drownes, R.L. et.al. (1986, April). Effects of frequent classroom testing. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco CA. (ERIC Document No. ED 274.

Ellis, J.A. & Wulfeck II, W.H. (1982). Handbook for testing in Navy schools (NPRDC SR 83-2). San Diego CA: Navy Personnel Research and Development Center. (AD-A122479).

Ellis, J.A. & Wulfeck II, W.H. (1986). Criterion-referenced measurement in military technical graining. In J>A. Ellis (Ed.), Military contributions to instructional technology (pp.60-82). New York: Praeger Publishers.

Roid, G. & Haladyna, T. (1982). A technology for test item writing. New York: Academic Press.

Samson, G.E., Graue, M.E., Weinsrein, T. & Walberg, H. J. (1984). Academic and occupational performance: a quantitative synthesis. American Educational Research Journal, 21 (2), 311-321. (ERIC Document No. EJ 303651).

Providing Feedback

Brophy, J. (1981). Teacher praise: A functional analysis. Review of Educational Research, 51 (1), 5-32.

Brophy, J., & Good, T.L. (1986). Teacher behavior and student achievement. In M.C. Wittrock (Ed.), Handbook of research on teaching (3rd ed., pp. 328-375). New York: Macmillan Publishing Company.

Lysakowski, R.S., & Walberg, H.J. (1981). Classroom reinforcement and learning: A quantitative synthesis. Journal of Educational Research, 75 (2), 69-77.

Orlich, D. (1985). Teaching strategies, A guide to better instruction. Lexington MA: Heath and Company.

Schimmel, B.J. (1983, April). A meta-analysis of feedback to learners in computerized and programmed instruction. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Canada. (ERIC Document No. ED 233708).

Managing Class Time

Karweit, N. Time on task reconsidered: Synthesis of research on time and learning. Educational Leadership, 41 (8), 32-35.

Stallings, J. (1980). Allocated academic learning time revisited: Beyond time on task. Educational Researcher, 9 (11), 11-16.

Walberg, H.J. (1984). What makes schooling effective? A synthesis and critique of three national studies. Contemporary Education Review, 1 (1), 22-34.

Wittrock, M.C. (1986). Students' thought processes. In M.C. Wittrock (Ed.), Handbook of research on teaching (3rd ed.), New York: MacMillan Publishing Company.

Cooperation in Learning

Johnson, D. W., Johnson, R.T., Maruyama, G. (1983). Interdependence and interpersonal attraction among heterogeneous and homogeneous individuals: A theoretical formulation and a meta-analysis of the research. Review of Educational Research, 53, 5-54.

Johnson, D.W., Maruyama, G., Johnson, R., & Nelson, D. (1981). Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. Psychological Bulletin 89 (1), 47-62.

Slavin, R.E. (1983). Cooperative learning. New York: Longman, Inc.

Smith, K.A., Johnson, D. W., & Johnson, R.T. (1981). The use of cooperative learning groups in engineering education. In L.P. Grayson & J.M. Biedenbach (Eds.), Proceedings: Tenth Annual Frontiers in Education Conference (pp. 29-32), Washington D.C: American Society for Engineering Education.

Peer Teaching

Bangert-Drowns, R.L., Kulik, J.A., & Kulik, C.C. (1983, Winter). Effects of coaching programs on achievement test performance, Review of Educational Research, 53, (4), 571-585.

Cohen, P.A., Kulik, J.A., & Kulik, C.C. (1982, Summer). Education outcomes of tutoring: A meta-analysis of findings. American Educational Research Journal, 19 (2), 237-248.

Goldschmid, B. & Goldschmid, M.L. (1976). Peer teaching in higher education: A review. Higher Education, 5(1), 9-33.

Montague, W. E. & Knirk, F. G. (1993) What works in adult instruction: The management, design and delivery of instruction. International Journal Educational Research. Vol 19, 327-443. Printed in Great Britain.

Slavin, R.E. (1983). Cooperative learning. New York: Longman, Inc.

Instructor Presentations

Rosebshine, B. & Stevens, R. (1986). Teaching functions. In M.C. Wittrock (Ed.), Handbook of research on teaching (3rd ed.). New York: MacMillan Publishing Company.

Rothkopf, E.Z. (1981). A macroscopic model of instruction and purposeful learning. Instructional Science, 10 (2), 105-122, (ERIC Document No.. EJ 250116).

Sullivan, H. & Higgins, N. (1983). Teaching for Competence. New York: Teachers College, Columbia University.

Thiagarjan, S. (1985). 25 ways to improve any lecture. Performance & Instruction Journal, 24 (10), 22-24.

Walberg, H.J. (1984,May). Improving the productivity of America's schools. Educational Leadership, 41(8), 19-36.

Practice

Druckman, D. & Bjork, A. (1991). In The Mind's Eye: Enhancing Human Performance. Committee on Techniques for the Enhancement of Human Performance; Commission on Behavioral and Social Sciences and Education; National Research Council; Washington DC: Academy Press.

Gettinger, M. (1984). Individual differences in time needed for learning: A review of the literature. Educational Psychologist, 19 (1), 15-29.

Robinson, E. R.. N., & Knirk, F.G. (1984). Interfacing learning strategies and instructional strategies in computer training programs. In F. A. Muckler (Ed.), The Human Factors annual review (vol. 1, pp. 209-238). Santa Monica CA: Human Factors Society.

Rothkopf, E.Z., & Coke, E.U. (1963). Repetition interval and rehearsal method in learning equivalences from written sentences. Journal of Verbal Learning and Verbal Behavior, 2, 406-416.

Schneider, W. (1985). Training high-performance skills: Fallacies and guidelines. Human Factors, 27 (3), 285-300.

Sullivan, H., & Higgins, N. (1983). Teaching for Competence. New York: Teachers College, Columbia University.

Promoting Mental Models

Anderson, R.C. (1977). The notion of schemata and the educational enterprise: General discussion of the conference. In R.C. Anderson, R.J. Anderson, R.J. Spiro & W.E. Montague (Eds.), Schooling and the acquisition of knowledge (415-431). Hillsdale NJ: Erlbaum Associates 415-431.

Gentner, D., & Stevens, A.L. (1983). Mental Models. Hillsdale, NJ: Erlbaum Associates.

Heller, J.I., & Reif, F. (1984). Prescribing effective human problem-solving processes: Problem description in physics. Cognition and Instruction, 1 (2), 177-216.

Kieras, D.E. (in press). What mental model should be taught: Choosing instructional content for complex engineered systems. In J. Psotka, D. Massey, and S. Mutter (Eds.), Intelligent tutoring systems: Lessons learned. Hillsdale NJ: Erlbaum Associates.

Motivating Students

Erickson, S.C. (1984). The essence of good teaching. San Francisco: Jossey-Bass.

Horn, E., & Walberg H. (1984). Achievement and interest as functions of quantity and level of instruction. Journal of Educational Research 77 (4), 227-232.

Rubin, L.J. (1985). Artistry in teaching. New York: Random House.

Urguroglu, M., & Walberg, H. (1979). Motivation and achievement: A quantitative synthesis. American Educational Research, 16 (4),, 375-389. (ERIC Document No. ED 206043).

Student Control of Learning

Bannister, B. D. (1986). Performance outcome feedback and attributional feedback: Interactive effects on recipient responses. Journal of Applied Psychology, 71 (2), 2033-210.

Bar-Tal, D. (1978). Attributional analysis of achievement-related behavior. Review of Educational Research, 48 (2), 259-271.

Kennelly, K. & Kinley, S. (1975). Perceived contingency of teacher administered reinforcements and academic performance of boys. Psychology in the Schools, 12, 449-453.

Schunk, D.H. (1985). Self-efficacy and classroom learning. Psychology in the Schools, 22, 208-223.

Stipek, D.J., & Weisz, J.R. (1981). Perceived personal control and academic achievement. Review of Educational Research, 51 (1), 101-137.

Urguroglu, M., & Walberg, H.J. (1979). Motivation and achievement: A quantitative synthesis. American Educational Research, 16 (4), 375-389. (ERIOC Document No. 6604352).

Out-of-class Assignments

Graue, M.E., Weinstein, T., & Walberg, H.J. (1983). School-based instruction and learning: A quantitative synthesis. Journal of Educational Research, 76 (6), 351-360.

Paschal, R.A., Weinstein, T., & Walberg, H.J. (1984). The effects of homework on learning: A quantitative synthesis. Journal of Educational Research, 78 (2), 97-104.

Walberg, H.J. (1983). Scientific literacy and economic productivity in international perspective. Daedulus, 112 (2), 1-28.

Walberg, H.J. (1983). Synthesis of research on teaching. In M.C. Wittrock (ed.), Third handbook of research on teaching. Washington DC: American Educational Research Association.

Walberg, H.J. (1984). Improving the productivity of America's Schools. Educational Leadership, 41 (8), 19-36.

Yeshurun, S. (1973). A reinforcement study on service courses in mathematics and statistics. International Journal of Mathematics Education in Science and Technology, 4 (2), 127-132.

TECHNIQUES FOR EDUCATION/TRAINING SPECIALISTS

Systematic Approaches

Andrews, D.H., & Goodson, L.A. (1980). A comparative analysis of models of instructional design. Journal of Instructional Development, 3 (4), 2-16.

Branson, R.K. & Grow, G. (1987). Instructional systems development. In R.M. Gagne (Ed.), Instructional technology: Foundations (pp.397-428). Hillsdale NJ: Lawrence Erlbaum Associates.

Montague, W.E., Wulfeck, W.H., & Ellis, J/A. (1983). Quality CBI depends on quality instructional design and quality implementation. Journal of computer-Based Instruction, 10 (3&4), 90-93.

Montague, W.E., Ellis, J.A., & Wulfeck, W.H. (1983). The Instructional quality inventory (IQI): A formative evaluation tool for instructional systems development (NPRDC TR 83-31). San Diego CA: Navy Personnel Research and Development Center.

Morgan, R.M. (1987). Planning for instructional systems. In R. M. Gagne (Ed.), Instructional technology: Foundations)pp. 379-396). Hillsdale NJ: Lawrence Erlbaum Associates.

Gott, S. (1990 Draft Paper). A Procedural Guide to Cognitive Task Analysis: The PARI Methodology; AFHRL Technical Paper. Wright Patterson Air Force Base OH: Air Force Human Resources Laboratory, Logistics and Training Division.

Training Objectives

Lawton, J.T., & Wanska, S. (1977). Advance organizers as a teaching strategy: A reply to Barnes and Clawson, Review of Educational Research, 47 (1), 233-244.

Kaplan, R., & Rothkopf, E.Z. (1974). Instructional objectives as directions to learners: Effect of passage length and amount of objective relevant content. Journal of Educational Psychology, 66 (3), 448--456. (ERIC Document No. EJ 106722).

Rothkopf, E.Z., & Kaplan, R. (1972). An exploration of the effect of density and specificity of instructional objectives on learning from text. Journal of Educational Psychology, 63, 295-302.

Sullivan, H., & Higgins, N. (1983). Teaching for Competence. New York: Teachers College, Columbia University.

Writing Materials

Gagne, R.M. (1986). Instructional technology: The research field. Journal of Instructional Development, 8 (3), 7-14.

Jonassen, D.H. (1985). The technology of text. Volume 2: Principles for structuring, designing and displaying text. Englewood Cliffs NJ: Educational Technology Publications.

Kern, R.P., Sticht, T.G., Welty, D., & Hauke, R.N. (1976, November). Guidebook for the development of Army training literature. Alexandria VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Nugent, G.C. (1982). Pictures, audio, and print: Symbolic representation and effect on learning. Educational Communication and Technology Journal, 30, 163-174.

Rothkopf, E.Z. (1982). Adjunct aids and the control of mathemagenic activities during purposeful reading. In W. Otto & S. White (Eds.), Reading expository material (pp.109-138). New York: Academic Press.

Reading Grade Level

Duffy, T. (1985). Readability formulas: What's the use? In T.M. Duffy & R. Waller (Eds.), Designing usable texts. New York: Academic Press.

Kern, R. (1979). Usefulness of readability formulas for achieving Army readability objectives: Research and state-of-the-art applied to the Army's problem. Fort Benjamin Harrison ID: Technical Advisory Service, U.S. Army Research Institute. (AD-A086408/2).

Kern, R. Sticht, T., Welty, D., & Hauke, R. (1977). Guidebook for the development of Army training literature (P-75-3). Alexandria VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD-A033935t).

Sticht. T. (1972). Learning by listening. In R. Freedle & J. Carroll (Eds.), Language comprehension and the acquisition of knowledge. Washington DC: V.H. Winston & Sons.

Sticht, T. (1985). Understanding readers and their uses of text. In T.M. Duffy & R. Waller (EDS.), Designing usable texts. New York: Academic Press.

Sticht, T., Armijo, L., Weitzman, R., Koffman, N., Roberson, K. Chang, F. & Moracco, J. (1986). Teachers, books, computers, and peers: Integrated communications technologies for adult literacy development (Summary progress report). Monterey CA: U.S. Naval Postgraduate School.

Built-on Knowledge

Bloom, B. (1976). Human characteristics and school learning. New York: McGraw-Hill.

Walberg, H.J., Strykowski, Rovai, E. & Hung S. (1984). Exceptional performance. Review of Educational Research, 54 (1), 87-112. (ERIC Document No. ED 72-07997).

Shavelson, R.J. (1974). Methods for examining representations of a subject-matter structure in a student's memory. Journal of Research in Science Teaching, 11 (3), 231-249.

Examples and Non-Examples

Bloom, B.S. (1968). Learning for mastery. Evaluation Comment, 1-12.

Gagne, E.D. (1985). The cognitive psychology of school learning. Boston: Little, Brown and Co.

Gagne, R.M. (1985). The Conditions of learning and theory of instruction. New York: Holt, Rinehart and Winston.

Merrill, M.D. (1983). Component display theory. In C.M. Reigeluth (Ed.), Instructional design theories and models: an overview of their current status. Hilldale NJ: Lawrence Erlbaum Associates.

Merrill, M.D. (1983). A lesson illustrating component display theory. In C.M. Reigeluth (Ed.), Instructional design theories and models: an overview of their current status. Hillsdale NJ: Lawrence Erlbaum Associates.

Merrill, M.D., & Tennyson, R.D. (1977). Teaching concepts: an instructional design guide. Englewood Cliffs, NJ: Educational Technology Publications.

Motivating Students

Erickson, S.C. (1984). The Essence of Good Teaching. San Francisco: Jossey-Bass.

Keller, J.M. (1983). Motivational design of instruction. In C.M. Reigeluth (Ed.), Instructional-design theories and models: An overview of their current status. Hillsdale NJ: Lawrence Erlbaum Associates.

Keller, J.M., & Dodge, B. (1982, September). The ARCS model of strategies for course designers and developers. Ft. Monroe VA: Training Developments Institute.

Horn, E., & Walberg, H. (1984). Achievement and interest as functions of quantity and level of instruction. Journal of Educational Research, 77 (4), 227-232.

Urguroglu, M., & Walberg, H. (1979). Motivation and achievement: A quantative synthesis. American Educational Research, 16 (4), 375-389. (ERIC Document No. ED 206043).

Designing Effective Illustrations

Levie, W.H., & Lentz, R. (1982). Effects of text illustrations: A review of research. Educational Communication and Technology Journal, 30 (3), 195-232.

Levin, J.R., Anglin, G.J., & Carney, R.N. (1987). On empirically validating functions of pictures in prose. In D.M. Willows & H.A. Houghton (Eds.), The psychology of illustration: I. Basic research. New York: Springer-Verlag.

Montague, W. E. & Knirk, F. G. (1993). What works in adult instruction: The management, design and delivery of instruction. International Journal of Educational Research. Vol. 19, 327-443. Printed in Great Britain.

.

Wulfeck, W.H., Chang, F. R., & Montague, W.E. (1986). Document and display design. In T. Sticht, F. Chang, & S. Wood (Eds.), Advances in reading/language research: Volume 4, Cognitive science and human resources management (pp. 183-195). Greenwich CT: JAI Press.

Formative and Summative Evaluations

Branson, R.K., & Grow, G. (1987). Instructional systems development. In R.M. Gagne (Ed.). Instructional technology: Foundations (pp. 397-428). Hillsdale NJ: Lawrence Erlbaum Associates.

Cambre, M.A. (1981). Historical overview of formative evaluation of instructional media products. Educational Communication and Technology Journal, 29, 2-25.

Dick, W., & Carey, L. (1985). The systematic design of instruction. (2nd edition). Glenview IL: Scott-Foresman.

Markle, S.M. (1967). Empirical testing of programs. In P.C. Lange (Ed.), Programmed instruction: The sixty-sixth yearbook of the National Society for the Study of Education, Part II. Chicago: University of Chicago Press.

Simulation

Blaiwes, A. S., & Regan, J.J. (1986). Training devices: Concepts and progress. In J.A. Ellis (Ed.), Military contributions to instructional technology (pp. 83-170). New York: Praeger Publishers.

Halff, H.M., Hollan, J.D. & Hutchins, E.L. (1986). Cognitive science and military training. American Psychologist, 41 (10), 1131-1139.

Schneider, W., Vidulich, M. & Yeh, Y. (1982) Training spatial skills for air-traffic control. Proceedings of the Human Factors Society (pp. 10-14). Santa Monica CA: Human Factors Society.

Semple, C.A., Hennesy, R.T., Sanders, M.S., Cross, B.K., Beith, B.H., & McCauley, M.E. (1981, January). Aircrew training devices: Fidelity features (AFHRL-TR-80-36). Wright Patterson Air Force Base OH: Air Force Human Resources Laboratory, Logistics and Training Division.

Criterion Referenced Testing

Bangert-Drownes, R.L. (1986, April). Effects of frequent classroom testing. American Educational Research Journal.

Ellis, J.A. & Wulfeck II, W.H. (1982). Handbook for testing in Navy schools (NPRDC SR 83-2). San Diego CA: Navy Personnel Research and Development Center. (AD-A122479).

Ellis, J.A. & Wulfeck II, W.H. (1986). Criterion-referenced measurement in military technical training. In J.A. Ellis (Ed.), Military contributions to instructional technology (pp. 60-82). New York: Praeger Publishers.

Roid, G. & Haladyna, T. (1982). A technology for test item writing. New York: Academic Press.

Samson, G.E., Graue, M.E., Weinstein, T., & Walberg, H.J. (1984). Academic and occupational performance: A quantative synthesis. American Educational Research Journal, 21 (2), 311-321. (ERIC Document No. EJ 303 651).

Maintaining Consistent Objectives, Testing, and Instruction

Ellis, J.A., & Wulfeck II, W.H. (1980, March). Assuring objective-test consistency: A systematic procedure for constructing criterion-referenced tests (NPRDC SR 80-15). San Diego CA: Navy Personnel Research and Development Center.

Ellis, J.A. & Wulfeck I, W.H. (1982). Handbook for testing in Navy schools (NPRDC SR 83-2). San Diego CA: Navy Personnel Research and Development Center. (AD-122479).

Ellis, J.A. & Wulfeck II, W.H. (1986). Criterion-referenced measurement in military technical training. In J.A. Elklis (Ed.), Military contributions to instructional technology (pp, 60-82). New York: Praeger Publishers.

Montague, W.E., Ellis, J.A., & Wulfeck II, W.H. (1983). Instructional quality inventory: A formative evaluation tool for instructional development. Performance and Instruction Journal, 22 (5), 11-14.

Time-sequencing Training

Dempster, F.N. (1987). Time and the production of classroom learning: Discerning implications from basic research. Educational Psychologist, 22 (1), 1-21.

Rothkopf, E.Z., & Coke, E.U. (1963). Repetition interval and rehearsal method in learning equivalence from written sentences. Journal of verbal Learning and Verbal Behavior, 2, 406-416.

Smith, S.M., & Rothkopf, E.Z. (1984). Contextual enrichment and distribution of practice in the classroom. Cognition and instruction, 1, 341-358.

Memory Aids

Bellezza, F.S. (1981). Mnemonic devices: Classification, characteristics and criteria. Review of Educational Research, 51 (2), 247-275.

Braby, R., Kincaid, J.P., with Aagard, J.A. (1978, July). Use of mnemonics in training materials: A guide for technical writers (TAEG Report No. 60). Orlando FL: Training Analysis and Evaluation Group.

Ericsson, K. A., & Chase, W. G. (1982). Exceptional Memory. American Scientist, 70 (6).

Montague, W. E. & Knirk, F. G. (1993). What works in adult instruction: The management, design and delivery of instruction. International Journal Educational Research. Vol. 19,

pp. 327-443. Printed in Great Britain.

Pressley, M, Levin, J., & Delaney, H. (1982). The mnemonic keyword method. Review of Educational Research, 52, 61-91.

Williams, S.S. (1979). Improving Memory: Developing imagery skills in returning adult students. Adult Education, 51 (5), 286-292.

PHYSICAL CLASSROOM ENVIRONMENT

Dunn, R. et. al. (1985). Light up their lives: A review of research on the effects of light on children's achievement and behavior. Reading Teacher, 38 (9), 863-869.

Knirk, F. G. (1979). Designing productive learning environments. Englewood Cliffs, NJ: Educational Technology Publications.

Knirk, F. G. (1987). Instructional facilities for the information age. IR-76. Syracuse, NY: ERIC Clearinghouse on Information Resources.

Montague, W. E. & Knirk, F. G. (1993). What works in adult instruction: The management, design and delivery of instruction. International Journal of Educational Research, Vol. 19, 327-443. Printed in Great Britain.

Sanders, M. S., & McCormick, E. J. (1987). Human factors in engineering and design (6th ed.). New York: McGraw-Hill Book Co.

Jones, D. M., & Broadbent, D. E. (1987). Noise. In G. Salvendy (Ed.), Handbook of human factors. New York: Wiley & Sons.

Woodson, W. E. (1981). Human factors design handbook: Information guidelines for the design of systems, facilities, equipment, and products for human use. New York: McGraw-Hill Book Co.

AUTOMATED TOOLS

Wall, J. (1991). Survey of Training Development Software Tools. Raytheon Service Company, 2 Wayside Road, Burlington MA 01803.

Attachment C - Abbreviations

AFH	AIR FORCE HANDBOOK
AFMAN	AIR FORCE MANUAL
AIMS	AUTOMATED INSTRUCTIONAL MEDIA SELECTION MODEL
AETC	AIR EDUCATION AND TRAINING COMMAND
ATC	AIR TRAINING COMMAND
CAI	COMPUTER AIDED INSTRUCTION
CALS	COMPUTER AIDED ACQUISITION AND LOGISTIC SUPPORT (CALS) HUMAN SYSTEM COMPONENTS COMMITTEE

CBT	COMPUTER BASED TRAINING
DIF	DIFFICULTY, IMPORTANCE AND FREQUENCY MODEL
ECA	EARLY COMPARABILITY ANALYSIS MODEL
GAIDA	GUIDED APPROACH FOR AN INSTRUCTIONAL DESIGN ADVISOR
GTET	GUIDELINES FOR TRANSPORTABLE EDUCATION AND TRAINING SYSTEM
GCASS	GTET COST ANALYSIS SUPPORT SYSTEM
GMISS	GTET MANAGEMENT INFORMATION SUPPORT SYSTEM
ICW	INTERACTIVE COURSEWARE
IQI	INSTRUCTIONAL QUALITY INVENTORY
ISD	INSTRUCTIONAL SYSTEM DEVELOPMENT
ISDA	INSTRUCTIONAL SYSTEM DEVELOPMENT AUTOMATION
IVD	INTERACTIVE VIDEO DISK INSTRUCTION
JS ISD/	JOINT SERVICE INSTRUCTIONAL SYSTEMS DEVELOPMENT
LSAR DSS	LOGISTICS SUPPORT ANALYSIS RECORD DECISION SUPPORT SYSTEM
LSA	LOGISTIC SUPPORT ANALSES
STAM	SUB TASK ANALYSIS MODEL
TAP	TEST ANALYSIS PACKAGE
TASCS	TRAINING ANALYSIS SUPPORT COMPUTER SYSTEM
TPDC	TRAINING AND PERFORMANCE DATA CENTER
TRACES	TRAINING COST ESTIMATOR SYSTEM
TRANS-FORM	TRAINING SYSTEM FOR MAINTENANCE